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PROPOSED PLAN OF MINING AND RECLAMATION

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TROY PROJECT
ASARCO INC.
LINCOLN COUNTY, MONTANA

Volume II

UNITED STATES FOREST SERVICE
KOOTENAI NATIONAL FOREST

STATE OF MONTANA
DEPARTMENT OF STATE LANDS

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DRAFT
ENVIRONMENTAL IMPACT STATEMENT

PROPOSED PLAN OF MINING AND RECLAMATION

TROY PROJECT - ASARCO

LINCOLN COUNTY, MONTANA

Prepared by

Montana Department of State Lands

U.S. Forest Service, Kootenai National Forest

Commissioner
Montana Department of State Lands

Floyd J. Marita
Forest Supervisor
Kootenai National Forest

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APPENDIX A

Proposed ASARCO Troy Project Wage Rates

TROY PROJECT WAGE RATES

Class	Job Title		Hourly Rates June 1, 1975
1	Leadman		$ 7.25
2	LHD Operator		$ 6.75
	Driller		
	Machinist	1st class	
	Mechanic	1st class	
	Mill Repairman	1st class	
	Welder	1st class	
	Electrician	1st class	
	Instrumentman		
	Plant Repairman	1st class	
	Drill Doctor		
3	Motor Grader Operator		$ 6.39
	Dozer Operator		
	Semi Highway Truck Driver		
	Loader Operator		
	Powderman		
	Roof Bolter		
	Equipment Operator		
4	Truck Driver		$ 6.20
	Field Lubeman		
	Mechanic	2nd class	
	Machinist	2nd class	
	Mill Repairman	2nd class	
	Welder	2nd class	
	Electrician	2nd class	
	Plant Repairman	2nd class	
	Crusherman		
	Ball Mill Operator		
	Flotation Operator		
	Pipe Man		
5	Lubeman		$ 6.02
	Crusher Operator		
	Utility Operator		
	Head Sampler		

(continued)

Class	Job Title	Hourly Rates June 1, 1975
6	Helper (Powder, Mill, Pipe, Roof Bolt, etc.) Town Truck Driver Tailing Dam Operator Sampler Lube Helper	$ 5.87
7	Laborer Bit Sharpener	$ 5.75

Shift Differential:

A -- -0-

B -- .20 $/Hr.

C -- .30 $/Hr.

TROY PROJECT DEVELOPMENT MANPOWER PHASE 1

		Pre-Mine Development	
		Number/Shift	Number/Day
Supervision			
Mine Superintendent		1	1
Supervisors		1	2
Engineer		1	1
Geologist		1	1
Engineer's Helper		1	1
Clerk		1	1
Subtotal		6	7
Operating Labor			
Miners	(LHD rate)	4	12
Helpers		2	6
Truck Drivers		1	3
Heavy Equipment Operators		1	3
Bit Grinders		1	3
Mechanics	1st class	1	3
Electrician	1st class	1	1
Welder	2nd class	1	1
Watchmen		1	3
Laborer		1	1
Subtotal		14	36
GRAND TOTAL		20	43

Note: Salary and wage rate are summarized under Phase III.

Development scheduled 24 hours/day; 5 days/week.

TROY PROJECT OPERATING LABOR PHASE II

	Number per Shift					Hourly
Job Title	A	B	C	D	Total	Rate
Mining Department						
Top Slice Stoping						
LHD Operators	1	1	1	1	4	$ 6.75
Drillers	6	4	4	4	18	6.75
Truck Drivers	2	2	2	-	6	6.20
Roof Bolters	2	2	2	-	6	6.39
Roof Scalers	2	2	2	-	6	6.39
Powdermen	1	1	-	-	2	6.39
Powder Helpers	2	2	-	-	4	5.87
Pipemen	1	1	-	-	2	6.20
Pipe Helpers	1	1	-	-	2	5.87
Motor Grader Operator	-	-	1	-	1	6.39
Dozer Operator	1	1	1	-	3	6.39
Leadman	1	-	-	-	1	7.25
Laborers	2	2	2	2	8	5.75
Stope Preparation						
LHD Operator	1	-	-	-	1	$ 6.75
Driller	2	-	-	-	2	6.75
Development						
LHD Operators	-	1	1	-	2	$ 6.75
Drillers	-	2	2	-	4	6.75
Subtotal	25	22	18	7	72	
Milling Department						
Underground Crushermen	1	1	1	1	4	$ 6.20
Underground Crusher Operators	1	1	1	1	4	6.02
Secondary Crushermen	1	1	1	1	4	6.20
Crusher Operators	1	1	1	1	4	6.02
Crusher Helpers	1	1	1	1	4	5.87
Laborer (Crusher)	1	-	-	-	1	5.75
Ball Mill Operators	1	1	1	1	4	6.20
Flotation Operators	1	1	1	1	4	6.20
Tailing Dam Operators	1	1	1	1	4	5.87
Helpers	2	1	1	1	5	5.87
Laborers	2	1	1	1	5	5.75
Utility Operator	1	-	-	-	1	6.02
Head Sampler	1	-	-	-	1	6.02
Sampler	1	-	-	-	1	5.87
Subtotal	16	10	10	10	46	

(continued)

Job Title		Number per Shift				Total	Hourly Rate
		A	B	C	D		
Mechanical Department							
Surface Shop							
Diesel Shop							
Mechanics	1st class	1	1	1	1	4	$ 6.75
Mechanics	2nd class	1	1	1	1	4	6.20
Helpers		1	1	1	1	4	5.87
Gas Shop							
Mechanic	1st class	1	-	-	-	1	$ 6.75
Machine Shop							
Machinist	1st class	1	-	-	-	1	$ 6.75
Weld Shop							
Welders	1st class	2	1	1	1	5	$ 6.75
Welders	2nd class	1	1	1	-	3	6.20
Helpers		1	1	-	-	2	5.87
Leadman		1	-	-	-	1	7.25
Electricians							
Electricians	1st class	2	1	1	1	5	$ 6.75
Electrician	2nd class	1	-	-	-	1	6.20
Instrumentman		1	-	-	-	1	6.75
Mill Repair							
Mill Repairmen	1st class	2	2	2	1	7	$ 6.75
Mill Repairmen	2nd class	2	2	2	1	7	6.20
Helpers		1	1	1	1	4	5.87
Surface Crew							
Equipment Operator		1	-	-	-	1	$ 6.39
Plant Repairmen	1st class	2	-	-	-	2	6.75
Plant Repairmen	2nd class	1	-	-	-	1	6.20
Town Truck Driver		1	-	-	-	1	5.87
Laborers		4	-	-	-	4	5.75
Subtotal		28	12	11	8	59	
GRAND TOTAL	Mine	25	22	18	7	72	
	Mill	16	10	10	10	46	
	Shop	28	12	11	8	59	
		69	44	39	25	177	

TROY PROJECT OPERATING LABOR PHASE III

Job Title	Number per Shift				Total	Hourly Rate
	A	B	C	D		
Mining Department						
Top Slice and Bench Stoping						
LHD Operators	3	3	3	3	12	$ 6.75
Drillers	8	8	6	6	28	6.75
Roof Bolters	2	2	2	-	6	6.39
Roof Scalers	2	2	2	-	6	6.39
Powdermen	1	1	-	-	2	6.39
Powder Helpers	2	2	-	-	4	5.87
Pipemen	1	1	-	-	2	6.20
Motor Grader Operator	-	-	1	-	1	6.39
Dozer Operators	2	1	1	-	4	6.39
Drill Helpers	2	2	2	2	8	5.87
Pipe Helpers	1	1	-	-	2	5.87
Laborers	3	3	3	3	12	5.75
Stope Preparation						
Drillers	2	2	-	-	4	$ 6.75
Development						
Drillers	2	2	-	-	4	$ 6.75
LHD Operators	1	1	-	-	2	6.75
Truck Drivers	2	2	-	-	4	6.20
Leadman	1	-	-	-	1	7.25
Subtotal	35	33	20	14	102	
Milling Department						
Underground Crushermen	1	1	1	1	4	$ 6.20
Underground Crusher Operators	1	1	1	1	4	6.02
Secondary Crushermen	1	1	1	1	4	6.20
Crusher Operators	1	1	1	1	4	5.02
Crusher Helpers	1	1	1	1	4	5.87
Laborer (Crusher)	1	-	-	-	1	5.75
Ball Mill Operators	1	1	1	1	4	6.20
Flotation Operators	1	1	1	1	4	6.20
Tailing Dam Operators	1	1	1	1	4	5.87
Helpers	2	1	1	1	5	5.87
Laborers	2	1	1	1	5	5.75
Utility Operator	1	-	-	-	1	5.02
Head Samper	1	-	-	-	1	5.02
Sampler	1	-	-	-	1	5.87
Subtotal	16	10	10	10	46	

(continued)

Job Title		Number per Shift A	B	C	D	Total	Hourly Rate
Mechanical Department							
Underground Shop							
Mechanics	1st class	2	2	2	2	8	$ 6.75
Mechanics	2nd class	1	1	1	1	4	6.20
Electrician	1st class	1	-	-	-	1	6.75
Electrician	2nd class	1	-	-	-	1	6.20
Welders	1st class	1	1	2	1	5	6.75
Lubemen		1	1	1	1	4	6.02
Helpers		2	2	2	1	7	5.87
Bit Sharpeners		3	3	3	-	9	5.75
Drill Doctors		2	-	-	-	2	6.75
Surface Shop							
Diesel Shop							
Mechanics	1st class	1	1	1	1	4	$ 6.75
Mechanics	2nd class	1	1	1	1	4	6.20
Helpers		1	1	1	1	4	5.87
Gas Shop							
Mechanic	1st class	1	-	-	-	1	$ 6.75
Machine Shop							
Machinist	1st class	1	-	-	-	1	$ 6.75
Weld Shop							
Welders	1st class	2	1	1	1	5	$ 6.75
Welders	2nd class	1	1	1	-	3	6.20
Helpers		1	1	-	-	2	5.87
Leadman		1	-	-	-	1	7.25
Electricians							
Electricians	1st class	2	1	1	1	5	$ 6.75
Electrician	2nd class	1	-	-	-	1	6.20
Instrumentman		1	-	-	-	1	6.75
Mill Repair							
Mill Repairmen	1st class	2	2	2	1	7	$ 6.75
Mill Repairmen	2nd class	2	2	2	1	7	6.20
Helpers		1	1	1	1	4	5.87

(continued)

Job Title		Number per Shift A	B	C	D	Total	Hourly Rate
Surface Crew							
Equipment Operator		1	-	-	-	1	$ 6.39
Plant Repairmen	1st class	2	-	-	-	2	6.75
Plant Repairmen	2nd class	1	-	-	-	1	6.20
Town Truck Driver		1	-	-	-	1	5.87
Laborers		4	-	-	-	4	5.75
Subtotal		42	22	22	14	100	
GRAND TOTAL							
	Mine	35	33	20	14	102	
	Mill	16	10	10	10	46	
	Shop	42	22	22	14	100	
		93	65	52	38	248	

TROY PROJECT STAFF PERSONNEL PHASE III

Job Title	Number per Shift A	B	C	D	Total
Unit Manager	1				1
Safety Engineer	1				1
Mining Department					
Mine Superintendent	1	-	-	-	1
Senior Mine Supervisors	1	1	-	1	3
Mine Supervisors	1	1	1	1	4
Drilling and Blasting Foremen	1	1	-	-	2
Milling Department					
Mill Superintendent	1	-	-	-	1
Mill Supervisor	1	-	-	-	1
Mill Foremen (4 crews)	1	1	1	1	4
Asst. Mill Foremen (4 crews)	1	1	1	1	4
Chief Metallurgist	1	-	-	-	1
Chief Chemist	1	-	-	-	1
Metallurgist	1	-	-	-	1
Mechanical Department					
Mechanical Superintendent	1	-	-	-	1
Asst. Mech. Superintendent	1	-	-	-	1
Shop Foremen (4 crews)	1	1	1	1	4
Mill Repair Foremen	1	1	1	-	3
*Ungrd. Shop Foremen (4 crews)	1	1	1	1	4
Electrical Foreman	1	-	-	-	1
Surface Foreman	1	-	-	-	1
Engineering					
Chief Engineer	1	-	-	-	1
Environmental Geologist	1	-	-	-	1
Production Trainee	1	-	-	-	1
Engineers	2	-	-	-	2
Engineers' Helpers	2	-	-	-	2
Draftsman	1	-	-	-	1

(*) Phase II, deduct Underground Shop Foremen.

Job Title	Number per Shift A	B	C	D	Total
Accounting					
Chief Accountant	1	-	-	-	1
Asst. Chief Accountant	1	-	-	-	1
Secretary	1	-	-	-	1
Receptionist-Typist	1	-	-	-	1
Clerks	2	-	-	-	2
Personnel	1	-	-	-	1
Purchasing Agent	1	-	-	-	1
Warehouseman	1	-	-	-	1
Miscellaneous					
Watchmen (Laborer rate)	1	1	1	1	4
Janitor (Laborer rate)	-	1	-	-	1
Total	38	10	7	7	62

Annual Salary Payroll = $ 956.880

Summary

Job Title	Number per Shift A	B	C	D**	Total
Mine	4	3	1	2	10
Mill	7	2	2	2	13
Mechanical	7	3	3	2	15
Engineering	8	-	-	-	8
Accounting	9	-	-	-	9
Miscellaneous	3	2	1	1	7
Total	38	10	7	7	62

(**) Swing crew for 7-day, 24-hour schedule.

APPENDIX B

Application to the Montana Department of Natural Resources and Conservation for Electric Transmission line to the proposed Mt. Vernon Mine

NORTHERN LIGHTS, INC.
P. O. BOX 310
SANDPOINT, IDAHO

APPLICATION

TO

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

ENERGY PLANNING DIVISION

HELENA, MONTANA

FOR

ELECTRIC TRANSMISSION LINE

TO

PROPOSED MT. VERNON MINE

OF

ASARCO, INC.
BOX 440
WALLACE, IDAHO

PREPARED BY
JAMES A. SEWELL & ASSOCIATES
NEWPORT, WASHINGTON

DECEMBER 29, 1977

APPLICATION FOR ELECTRIC TRANSMISSION LINE

This application for Northern Lights, Inc. is for a 115 Kv transmission line with a 24.9 Kv underbuild part of its length. This transmission line will extend from the Bonneville Power Administration substation approximately one mile east of Troy, Montana southerly along Northern Lights' existing distribution line right of way to the proposed access road to the proposed Mt. Vernon mine and thence generally along said access road to the mine, a total distance of approximately 18 miles.

ASARCO has made studies of the general area through which the transmission line passes and has filed the studies with the State Department of Lands in connection with their application for the proposed mine. These studies are listed later in this application.

This transmission facility is required to provide the power for the operation of the proposed mine and mill since it is not economically feasible to provide at-site generation and it is felt that this proposal will have less environmental impact on the area than at-site generation.

This 115 Kv transmission facility is planned to be located on the Northern Lights existing right of way and thus will provide far less environmental impact than if a new line was constructed. This will be accomplished by re-constructing the new line with single pole structures wherever possible with the 115 Kv circuit on the top of the pole and the 24.9 Kv underbuild circuit located below to provide service to existing customers. Therefore, in considering the environmental factors involved, this location was believed to be highly superior to a new route for the transmission line.

The following information is submitted as required under the Energy Planning Division rules and regulations, paragraph 36-2.8(2)-S830 and are numbered in accordance with paragraph (1) thereof.

(a) The transmission of electricity is required from the BPA Substation at Troy to serve a load of approximately 18 megawatts at the ASARCO Incorporated's proposed mine and concentrator complex south of Troy, Montana. A detailed description of the ASARCO facility known as the Troy Project has been previously submitted to DNR and is entitled "Troy Project Operating Plan" dated May 14, 1976. This block of power is necessary for the mine and the process which includes size reduction of mineral bearing rock and the physical concentration of the minerals. This concentration of the ore saves the energy necessary to transport large quantities of mineral bearing rock to another locale where it would still have to be reduced prior to smelting. Instead, only the concentrate is trucked to Troy for rail shipment to the smelter.

This transmission line will be designed, constructed, and owned by Northern Lights, Inc. with ASARCO advancing funds for the construction which will be credited against the purchase cost of the power used by them through the life of the project. The size of the load was determined in the economic feasibility of the mine and mill. This requires a certain size mill to make an economical operation of the project.

Transmission load flow studies were made by BPA and the results are shown in Exhibit 10.

(b) Transmission of electricity is the only practical source of power of this magnitude. Diesel generation of power on site was investigated; however, the generation cost was prohibitive, the supply could be disrupted through oil embargo, and the U. S. balance of payments might be adversely affected.

Purchase of a used 25 megawatt diesel generator was found to give a cost per kilowatt-hour of about $0.04 opposed to somewhat cheaper costs from Northern Lights. The diesel exhaust would be emitted into the atmosphere having an environmental impact and a discharge permit for this exhaust would be necessary.

115 Kv transmission was chosen because it is economically justified by lower line losses, and similar construction cost due to industry standardization.

A loop line to increase reliability is not feasible as it would more than double the line costs. In addition, feed to this area from a different source would entail a transmission corridor approximately 28 miles in length.

(c) The upgrading of the existing rural line will more than double the present capacity (12.470 Kv to 24.9 Kv). With an estimated 6.5% increase in load annually, this line, when upgraded, will serve the anticipated loads for the next 44 years. The 115 Kv circuit for ASARCO service will not have to be upgraded and will require only normal maintenance for the ± 20 years operating life of the mine.

The estimated connected load for the ASARCO project is 18,525 Kva. The estimated demand is 14,084 Kva.

(d) The existing 12.470 Kv line will be upgraded to 24.9 Kv although at this time demand does not require the improvement. This will eliminate the need to upgrade at a later date as demand increases. Replacement of the old line will provide more reliable service to existing customers. The existing line is old and the ASARCO project only accelerates the inevitable replacement of the existing distribution line.

(e) The preferred transmission corridor follows an existing line to State Highway #202 and then along this highway to the point at which the new road to the mine leaves the highway, and then follows generally along the new road as shown on the attached maps. (Exh. 1).

This routing of the line seems advisable since it has the minimum impact on the environment. The entire area is generally mountainous and to follow a route that was not along existing roads would make it very costly to construct and maintain as well as disturbing the environment to a much higher degree.

(i) The social impact of this transmission line will be the providing of better service to all of the existing customers as well as providing for the area growth.

(ii) Northern Lights, Inc. will pay taxes on this line as on their other facilities in Montana. Some local income will be generated by the hiring of about 10 local people to aid in the construction, which will last 4-6 months. Governmental income will increase slightly because of the increased personal income of the construction work force. There will be no increased governmental spending in education, welfare, roads, medical care, law enforcement, or other services because of this line.

Economic factors involved in the construction of this line are:

1. Construction and operating costs. Total estimated cost of this transmission line is $1,068,031.08. This cost amounts to $67,069.00 per mile for the existing section and $62,382.00 per mile for the portion to the water wells. The portion from the wells to the substation, which is a single circuit 115 Kv only is $46,364.00 per mile. These figures are based on cost estimates shown in Exhibit 2.

2. Northern Lights, Inc. will pay annual taxes on this line of approximately $12,576.00 for this facility. A filing fee of $20,680.31 accompanies this application.

3. Some local income will be generated by the hiring of about 10 local people to aid in construction of this line, with about 20 persons coming into the area to supervise the construction.

4. Governmental income will be increased slightly because of the increased personal income of the above individuals.

5. There will not be any increased governmental spending in education, welfare, roads, medical care, law enforcement, or other services because of this line.

(iii) The following reports have been made available to your department through the Department of State Lands (Ralph Driear) which has been appointed the State's lead agency for preparation of an EIS on ASARCO's proposed mine known as the Troy Project.

1. Environmental Baseline information of the Mount Vernon Region by Stearns-Roger Corporation dated 1-31-75.
2. Troy Project Operating Plan dated 5-14-76.
3. Relation between Troy Project and the hydrology of the vicinity, Lincoln County, Montana by Water Development Corporation dated 12-13-76.
4. Troy Project Mining and Reclamation Plan dated 12-13-76.
5. The Department of State Lands (contact Ralph Driear) can also supply recent studies being carried out by various State agencies and outside contractors, which further describe the environment.
6. The Department of Natural Resources and Conservation has conducted an environmental analysis of the transmission line impact under our contract with the Montana Department of State Lands.

These studies were submitted to the above described agencies and this submittal serves as proof of service to these two agencies.

(iv) There is basically no effect on the cultural environmental factors in this area as the line either follows the existing location or is along the new road right of way except for a short distance near the mine. The topography is steep with wooded hillsides which have no real recreational, agricultural or industrial uses.

(f) Drawing and map included as follows:

(i) The preferred and alternate route of the transmission corridor is shown on Exhibit I which is the overall map of the area consisting of two sheets.

(ii) Drawings of preferred and alternative architectural designs for facilities such as electric transmission structures, aqueducts, substations and pump stations shall be submitted.

Exhibits 3 through 9, Drawings of transmission line structures. Note that Th-3A, 4A, 5A and TS-115 will be used only as necessary. These are angle structures and their use will be minimized.

(g) Description of engineering design specifications or criteria as follows:

(i) For electric transmission lines:

(aa) Conductors by material type, cross section, midspan ground clearance, spacing between phases, etc.:
Conductor: Transmission 3-4/0 ACSR, 0.563 inch diameter, 25 foot minimum midspan ground clearance or 9/-0" above underbuild, phase spacing at poled 6'-10¼".
Underbuild 24.9 Grd. wye/14.4Kv 3-4/0 ACSR and 1-1/0 ACSR 0.563 inch diam. and 0.398 inch diam. 22 foot minimum midspan ground clearance, phase spacing at poles 3'-6½".

(ab) Lightning protection system:
Lightning protection is not considered necessary in this area.

(ac) Insulators by size, material:
Insulators used are of five types and three materials.
a. The most common are porcelain insulators of which there are three types.
1. 10" disc suspension insulators (Transmission).
2. Pin type insulators (underbuild).
3. Line post insulators (Transmission).
b. The second material and fourth type is combination of fiberglass member and an ethylene propylene copolymer which forms a horizontal post insulator.
c. The third material and fifth type insulator is a fiberglass rod used as a crossarm to eliminate some 10" disc insulators.

(ad) Thermal capacity and rating:
The thermal capacity of this line is 340 amperes which gives a maximum capacity of 67.7 Mva at 115 Kv and 14.7 Mva at 24.9 Kv.

(ae) Power losses as percentage of load and Kva rating:
The maximum losses at .92 power factor will be 2.75 percent.

(af) Physical reliability of line due to geographic location and condition:
The reliability of this line should be excellent as it is mostly in the presently existing right of way and along the highway.

(ag) Substations:
There will be a new switching structure in the existing Bonneville Power Administration's Troy substation and a new substation with two 12/15 MVA 115 to 4.16 Kv transformers at the Mt. Vernon Mine.

(ah) Planned operational voltage:
The planned operating voltages for this line are 115 Kv Troy to Mt. Vernon Mine and 12470 Volts Troy to the well location.

(ai) Critical voltage:
The critical line voltage will be the transmission or 115 Kv portion. The critical voltage gradient has not been calculated. The texts and other data we have found infer that there is no problem below 230 Kv.

(aj) Radio and Television Interference Problems:
1. All power lines from low voltage to high voltage have presented problems in the field of radio and television interference. There will probably be an increase in this interference because of the higher voltage class of this line. We feel, however, that with proper maintenance and construction procedures, all of the effects of this increase can be minimized.

It is possible that some antennas may need to be moved because of the rebuilt line. The advantage of increased reliability of service far outweighs the chance of increased radio noise. The widening of the right of way will also help reduce interference because tree limbs will not be likely to strike the line.

(ak) Historical outage data.
Outages on this section of line January 1973 through November 1977 are summarized below:

No. Outages	Cause	Consumers Affected		Duration in hours
		Rural Res.	Seasonal	
7	Tree	7 to 86 Ave. 64	0 - 40 Ave 4	1-9½
2	Tree-wind	71 & 71	0	3 & 7
2	Wind	86 & 86	0 & 47	3½ & 5½
1	Snow	71	0	5
1	Broken Insulator	71	40	2
1	Flood	71	40	5½
1	Rotton Pole	71	0	3½

There should be fewer tree caused outages with the rebuilt line because of the wider rights-of-way.

(h) Construction analysis, as follows;

(i) This line will be installed by a qualified contractor, and inspected by Northern Lights, Inc. or their authorized agent. Northern Lights will not have control of the size and variation in size of the contractor's crews but will have a time limit on the construction of the contract.

(ii) The contractor will probably erect all of the structures and then string the conductors on these structures for the new construction. The portion built along the existing line will be constructed in sections as it is necessary to keep outages to existing customers at a minimum. It is expected the maximum line outages will be 4 hours and the line will have to be returned to service at night. These outages can be held to a minimum by energizing the line from the Noxon end during construction. The construction starting date is contingent upon ASARCO obtaining all the necessary operating permits for the Troy Project and their decision to proceed to develop the mine-mill complex.

(iii) It is anticipated that the contractor will use cranes or boom trucks to erect the poles. However, if any hillsides are too steep, the erection may be done by hand.

(iv) The area under the line is presently natural grass and shrubs which will be allowed to continue to grow but the area must necessarily be kept free of trees.

1. The width of right of way for the existing line kept clear of trees is 20 feet. The necessary width for 115 Kv horizontal post structures is 30 feet. The width necessary for two pole structures is 50 feet.

2. There are no new roads presently planned or expected to be necessary for line construction. The roads built for mine access will be used for construction roads. If any new roads are necessary, they will be returned to their natural state and replanted after completion of construction.

All communications concerning this application shall be sent to James A. Sewell and Associates, Attn: James A. Sewell, Engineer, P. O. Box 160, Newport, Washington 99156, telephone 509/447-3626, with copies to Northern Lights, Inc., P. O. Box 310, Sandpoint, Idaho 83864.

Proof of service to municipalities, government agencies and populace in general are shown in Exhibits 11 and 12.

NORTHERN LIGHTS, INC.

By William T. Nordeen

December 29, 1977

William T. Nordeen, Manager

APPENDIX C

Driller's Logs of Tailing Impoundment Monitor Wells No. 1 and No. 2

DRILLER'S LOG OF MONITOR WELL NO. 1

Material	Thickness (ft)	Depth (ft)
Tan silty sand	6	6
Brown silt and fine brown sand	15	21
Brown sand embedded in brown silt	19	40
Brown sand, silt, and wood	14	54
Gray silt, sand, and wood, seeps of water	22	76
Gray silt and wood, seeps of water	23	99
Fairly clean, fine gray sand, water	6	105
Brown and yellow silty sand, some water	29	134
Dark tan silty clay	14	148
Silty gravel with some water	3	151
Brown silty sand and water	4	155
Gravel embedded in tan silt	4	159
Course sand and fine gravel, silt	3	162
Gravel embedded in tan silt	5	167
Clean gravel and water	116	283
Real silty gravel and water	7	290
Total depth		290

DESCRIPTION OF DRILL CUTTINGS FROM MONITOR WELL NO. 1

Material	Thickness (ft)	Depth (ft)
Fine silt and clay	5	5
Clay and silt	10	15
Clay and silt, some fine sand	5	20
Clay, silt, and fine sand	5	25
Fine sand, silt, and clay	15	40
Silt, fine sand, and clay	20	60
Silt, clay, and fine sand	5	65
Clay, silt, and some fine sand	5	70
Clay and silt	20	90
Fine sand, silt, and clay	9	99
Fine sand and silt	6	105
Silt to medium sand	10	115
Silt to fine sand	15	130
Silt to very fine sand	5	135
Silt with some very fine sand	5	140
Silt	5	145
Silt with some very fine sand	3	148
Silt with sand to small gravel	3	151
Medium to very fine sand, silt	4	155
Silt, some sand and gravel	4	159
Clean medium to coarse sand, some gravel	6	165
Silt matrix, medium to coarse sand, some gravel	5	170
Very fine to coarse sand, some gravel, fairly clean	10	180
Very fine to fine sand, fairly clean	8	188
Gravel, some fragments 1/2" plus	7	195
Gravel	5	200
Medium to coarse sand, some gravel	5	205
Gravel	10	215
Coarse sand and gravel	10	225
Fine sand to gravel, fragments to 1/4" plus	5	230
Fine to coarse sand, some gravel	5	235
Fine to very coarse sand, some gravel	5	240
Fine to medium sand, very uniform	30	270

DESCRIPTION OF DRILL CUTTINGS FROM MONITOR WELL NO. 1
(continued)

Material	Thickness (ft)	Depth (ft)
Fine to very coarse sand, some gravel	5	275
Fine to very coarse sand	5	280
Missing; described by driller as real silty with gravel	10	290
Total depth		290

DRILLER'S LOG OF MONITOR WELL NO. 2

Material	Thickness (ft)	Depth (ft)
Tan silt	15	15
Greenish gray silt	30	45
Gray silt, seeps of water, some wood	58	103
Gray silt, seeps of water	62	165
Fine gray silty sand, water	18	183
Gray silt and water	7	190
Gray silty clay with seams of gravel with water	35	225
Total depth		225

DESCRIPTION OF DRILL CUTTINGS FROM MONITOR WELL NO. 2

Material	Thickness (ft)	Depth (ft)
Silt	15	15
Silt, some clay	10	25
Silt and clay, some organic materials	5	30
Silt and clay	10	40
Clay and silt	10	50
Silt and clay	10	60
Clay and silt	10	70
Silt and clay	5	75
Clay and silt	5	80
Silt and clay	35	115
Clay and silt	10	125
Silt and clay	40	165
Silt to fine sand, some clay	5	170
Silt to medium sand, little clay	10	180
Sand to coarse gravel, some silt	5	185
Silt to medium sand, some gravel and clay	5	190
Silty clay to coarse gravel	5	195
Silt to medium gravel	5	200
Silt to coarse gravel	5	205
Clay to silt, some sand	5	210
Silt to gravel	10	220
Fine sand to gravel	5	225
Total depth		225

APPENDIX D

1) Summary of Hydrologic Factors for Tailing Pond

2) Water Reclaimable and Accumulated Volume in Storage in Tailing Pond, Assuming Partial Freezeup in Winter

TABLE 32

SUMMARY OF HYDROLOGIC FACTORS FOR TAILING POND

Halpenny and Green, 1976

Item of Water	Annual Volume (ac-ft)	Unit Volume (gpt)	Operating Day Flow Rate		Operating Day Total Volume (mgd)
			(gpm)	(cfs)	
Delivered to pond in slurry	2,160	240	1,417	3.2	2.040
Collected at pond as net precipitation	566	63	371	.8	.535
Stored in tailings at pond	711	79	466	1.0	.672
Infiltration	180	20	118	.3	.170
Reclaimable for mill use, Table 30	1,835	204	1,204	2.7	1.733
Reclaimable for mill use, Table 31	1,835	204	1,204	2.7	1.733
Makeup water required at mill	2,228	248	1,461	3.3	2.104
Operating demand on primary wat supply 1/	393	44	257	.6	.371

1/ After first few months of operation.

TABLE 31

WATER RECLAIMABLE AND ACCUMULATED VOLUME IN STORAGE IN TAILING POND, ASSUMING PARTIAL FREEZEUP IN WINTER

(All figures in acre-feet)

Halpenny and Green, 1976

Month	Total Water From Mill	Total Water From Precipitation	Water Retained in Tailings	Water Lost by Infiltration	Water Input All Sources	Snow and Ice Frozen (-) Melted (+) 1/	Net Water Available for Reclaim	Mill Require-ment	Water Reclaimed for Mill	Accumulated	
										Water in Pond	Snow and Ice in Pond
October	+ 194	+ 97	- 64	- 15	+ 212	0	212	200	200	12	0
November	+ 188	+ 153	- 62	- 15	+ 264	0	276	194	194	82	0
December	+ 69	+ 188	- 22	- 15	+ 220	- 205	97	71	71	26	205
January	+ 194	+ 208	- 64	- 15	+ 323	- 256	93	200	93	0	461
February	+ 175	+ 104	- 57	- 15	+ 207	- 148	59	181	59	0	609
March	+ 194	+ 94	- 64	- 15	+ 209	- 94	115	200	115	0	703
April	+ 188	+ 59	- 62	- 15	+ 170	+ 176	346	194	194	152	527
May	+ 194	- 53	- 64	- 15	+ 62	+ 527	741	200	200	541	0
June	+ 188	- 44	- 62	- 15	+ 67	0	608	194	194	414	0
July	+ 194	- 142	- 64	- 15	- 27	0	387	200	200	187	0
August	+ 194	- 99	- 64	- 15	+ 16	0	203	200	200	3	0
September	+ 188	+ 1	- 62	- 15	+ 112	0	115	194	115	0	0
TOTAL	+ 2,160	+ 566	- 711	- 180	+ 1,835	0		2,228	1,835		

1/ Based on the following assumptions:

(a) Snow in period Dec. 1-Mar. 31 remains as snow and not available for reclaim until melted.

(b) Twenty-five percent of total water from mill freezes in period Dec. 1 - Feb. 28 and not available for reclaim until melted.

(c) During April 1-30, 25% of snow and ice melts and becomes available for reclaim.

(d) During May 1-31, remaining 75% of snow and ice melts and becomes available for reclaim.

APPENDIX E

Troy Ranger Station Climatic Data 1967 - 1976

Troy Years of Record - Temperature-15 - Precipitation-15

	Year	1	2	3	4	5	6	7	8	9	10	11	12	Average
Average Monthly Temperature														
Troy	1976	26.9	28.9	30.2	41.4	52.4	63.3	63.9	63.9	57.7	43.4	31.9	27.9	43.5
	1975	21.8	21.6	30.2	36.8	47.6	54.7	68.6	60.4	55.5	42.9	30.5	28.0	41.6
	1974	21.8	29.5	31.7	41.4	44.9	61.0	63.1	62.2	54.9	42.8	32.6	27.9	42.8
	1973	16.2	28.9	36.5	41.5	51.5	57.8	64.5	64.9	55.8	43.2	28.1	26.7	43.0
	1972	17.3	28.4	36.0	38.1	52.2	58.6	61.7	66.4	51.1	43.3	34.8	20.4	42.4
Total		104			198.2			321.2			215.6			213.3
Average		20.8			39.64			64.24			43.12			42.66

	Year	Total Precipitation	Frost Free Days
	1976	27.91	94
	1975	40.81	88
	1974	45.99	134
	1973	35.36	96
	1972	36.27	109
Average			104.2

Daily Variations

Troy - H 94 (06/76)
L -16 (01/74)

Rainfall by Month-Troy - 1967-1976

Month	1976	1975	1974	1973	1972	1971	1970	1969	1968	1967
1	3.40	4.49	10.39	3.93	6.57	8.82	5.30	5.96	4.36	3.85
2	5.02	5.23	4.04	1.09	5.77	2.05	3.34	2.04	3.15	1.06
3	2.15	2.96	6.37	2.08	2.46	3.70	2.17	1.64	3.35	2.03
4	1.94	1.87	3.10	.94	2.31	2.92	2.78	2.29	2.31	.66
5	1.80	2.63	1.89	1.50	1.51	1.45	1.13	3.32	2.52	1.27
6	2.16	1.64	2.76	2.91	2.72	2.43	1.87	4.92	2.71	2.30
7	1.06	.69	1.96	.15	2.37	1.32	1.15	.49	1.84	.50
8	4.78	3.49	1.06	.70	.77	1.28	.20	.04	2.50	.07
9	.30	.64	1.25	1.84	1.79	1.72	2.58	3.92	5.68	.42
10	1.80	5.83	.27	2.47	2.16	3.08	2.04	2.38	5.50	7.97
11	1.74	3.54	7.83	10.81	2.10	3.98	2.96	2.14	5.13	2.94
12	1.76	7.80	5.07	6.94	5.74	6.37	6.16	3.33	5.12	3.85
TOTAL	27.91	40.81	45.99	35.36	36.27	39.12	31.68	32.47	44.16	26.92

Average Precipitation - October through March.

15.87 - 27.91 - 57 percent 1976
29.85 - 40.81 - 73 percent 1975
33.97 - 45.99 - 74 percent 1974
26.87 - 35.36 - 76 percent 1973
24.80 - 36.27 - 68 percent 1972
28.00 - 39.12 - 72 percent 1971
21.97 - 31.68 - 69 percent 1970
17.49 - 32.47 - 54 percent 1969
26.61 - 44.16 - 60 percent 1968
21.70 - 26.92 - 81 percent 1967

Average - 68.4 percent

APPENDIX F

Surface Water System Descriptions

The Lake Creek Drainage System

The Lake Creek drainage system originates in high mountains upstream from Bull Lake. The major drainage above Bull Lake is Ross Creek which flows into Bull Lake. Lake Creek proper begins at the outlet of Bull Lake and has two major tributaries - Stanley Creek and Keeler Creek and numerous smaller tributaries including Falls, Felix, Iron, Copper, Twin, Porcupine, Camp, and Dry Creeks.

Bull Lake

Bull Lake is approximately 4.5 miles long and ½ mile wide and has about 1,250 surface acres. State Highway 202 is located along the east side of the lake, and there are a number of recreation homes on Callows (Angel) Island along the east lake shore. The main stream supplying Bull Lake is Ross Creek which is tributary to the lake at the south end. A number of small intermittent or perennial streams including Upham, Noggle, Payne and Cromwell Creeks enter Bull Lake along its east shore. Stanley Creek enters Bull Lake at the extreme northern end where the lake acts as a wide, shallow, slow moving river that is the beginning of Lake Creek.

Spar Lake

Spar Lake is a large lake of approximately 390 acres located about three miles from Mt. Vernon. The lake is formed by a glacial moraine which blocked the ancient drainage of Fairway Creek. Below Spar Lake is the headwaters of Fairway Creek, created by springs originating from water seeping from Spar Lake through the glacial moraine. Spar Lake water levels fluctuate substantially as a result of the balance between inflow into Spar Lake and seepage. There are several tributaries to Spar Lake which originate in the 15 square mile watershed around the lake. Spring snowmelt from these small watershed runs into Spar Lake and is then released slowly by seepage through the moraine. Data collected by ASARCO showed a fluctuation of about 40 feet in Spar Lake from June of 1974 to October of 1976. Based on these records (WADEVCO, 1976, P. 4-2), the lake level declined about 0.3 feet/day during the summer months, which is equivalent to about 55 to 60 cfs. This is similar in volume to the flow in Fairway and suggests the lake is the major source of water in Fairway Creek.

Lake Creek

Lake Creek has about a 210 square mile drainage area and begins at Bull Lake and flows northward about 13 miles to join the Kootenai River near the community of Troy, Montana. The two major tributaries, Stanley and Keeler Creeks, provide the majority of the water in Lake Creek during normal flow conditions. The gradient of Lake Creek is moderate (17 to to 19 feet/mile) but becomes more gentle (15 feet/mile) four to five miles above the Kootenai River. Lake Creek then meanders through a relatively flat bottom land until it reaches Troy Dam where it is impounded.

Stanley and Keeler Creek have substantial baseflows, and they provide Lake Creek with streamflow throughout the year. Lake Creek flow measurements made during this investigation by WESTECH are:

Date	(LCI) Lake Creek Below Stanley Ck. cfs	(LC2) Lake Creek Above Porcupine Ck. cfs	(LC4) Lake Creek Near Mouth cfs
April 20/77	142		
May 4/77	405		
June 25-26/77	93	87	147
July 20-21/77	65	70	140
October 25/77	56	53	114
Feb. 10/78	85.5	89.2	190

Twelve previous flow measurements on Lake Creek below Stanley Creek (LCI) reported by WADEVCO for the period October 1973 to October 1976 (1976 p. 4-7) show flows ranging from 51.7 to an estimated 1400 cfs. Flood flow in Lake Creek for the 100-year recurrence interval is estimated to be 5250 cfs and for the 170 square mile area above the tailings pond is estimated to be 4250 cfs (WADEVCO 1976, p. 10-2). Based on available data the change in streamflow between stations LCI and LC2 cannot be determined due to the normal error in stream gaging. Lake Creek gains considerable water downstream but most of the gain is attributed to Keeler Creek.

A USGS sampling station is maintained on Lake Creek at a point about 5 miles downstream from the proposed tailings pond (30N33W8BBC).

Flow data from this station are as follows:

Date	Flow cfs	Date	Flow cfs
July 14/76	560	Jan. 12/77	125
Aug. 18/76	255	Feb. 9/77	101
Sept. 21/76	179	April 20/77	240
Oct. 19/76	140	April 28/77	660
Nov. 16/76	140	May 25/77	365
Dec. 13/76	130	June 23/77	174
		July 20/77	130
		Aug. 23/77	90
		Sept. 20/77	100
		Nov. 28/77	195
		Feb. 22/78	105

A USGS gaging station was operated on Lake Creek at Troy from October, 1945 to September, 1957. During this period the average flow was 517 cfs, a maximum of 3250 cfs and a minimum of 55 cfs.

In January, 1974, Lake Creek flowed at a peak of 7000 cfs with a water yield of 33.4 cfs per square mile of water. This is a very large water yield, and is evidence of high transport energy in this stream system.

Kootenai River

Lake Creek enters the Kootenai River just upstream from the community of Troy, Montana. The Kootenai enters Montana from British Columbia, flows across the northwestern corner of the state, and exits into Idaho. It then flows back into British Columbia.

The Kootenai is a major river system and has a drainage area of approximately 10,240 square miles above the gaging station near Libby, Montana. Its three major tributaries in Montana are the Yaak, Fisher and Tobacco Rivers. The completion of Libby Dam in 1973 allows nearly complete control of flow of this river. The Fisher and Yaak Rivers and smaller tributaries such as Lake Creek enter the Kootenai downstream of Libby Dam. The average flow of the Kootenai River at Libby, Montana for 61 years of record is 12,210 cfs (USGS, 1976).

Libby Dam is used to produce electrical power and downstream flowsare highly variable. A reregulating dam is planned downstream from Libby Dam to smooth out these water flows.

Releases from Libby Dam in 1974-1975 ranged from 2,000 to 30,400 cfs. The Kootenai River drainage is sparcely populated and is largely undeveloped.

Stanley Creek

A major portion of the proposed mining activity will occur in the Stanley Creek drainage. Stanley Creek, above its confluence with Lake Creek, drains an area of approximately 12 square miles. The length of the defined channel extending from Bull Lake upstream to the northern flank of Mount Vernon, is about four miles. The watershed is characterized by steep slopes, thin soils, moderate to dense vegetation, and it receives a mean annual precipitation of about 50 inches at the lower end (elevation 2700 feet) to about 90 inches at the upper end (elevation 5580 feet). There are two small forks at the upper end of the stream created by springs and these two forks join to form a main channel. At the confluence of these forks is one proposed adit location. (Figure). During the period of this investigation, flow below the confluence of these forks was measured. (Station shown on Figure).

Results are as follows:

Date	Flow (cfs)
June 26/77	2.1
July 20/77	1.0 (est.)
Sept 25/77	1.35
Oct. 25/77	2.0

During normal stages, flow in Stanley Creek continues downstream from the proposed adit location for approximately one-half mile, where it infiltrates into the ground within a length along the streambed of about 200 feet. At this point, the stream gradient is less steep than upstream areas, and is underlain by unconsolidated alluvial materials. From this location downstream approximately two miles to its confluence with Fairway Creek, Stanley Creek is normally dry except during the spring runoff season. This stream segment probably transports the flow of upper Stanley Creek as underflow. This groundwater probably resurfaces as stream flow in lower Stanley Creek, but this hydrologic system has not been thoroughly investigated. This stream segment flowed water from about mid-April through May in 1977.

Below its confluence with Fairway Creek, Stanley Creek is a relatively large perennial stream. A small tributary, Thicket Creek, enters Stanley Creek below Fairway Creek. Thicket Creek has a drainage area of approximately two square miles and contains heavy vegetation, marshy areas, and has been observed to have a fairly continuous base flow of about 0.5 to 3 cfs.

Stanley thus has a perennial upper segment, an intermittent middle segment that flows only during spring runoff or after large rainfall events, and a perennial lower segment. When there is no streamflow in the middle segment, flow in the lower segment is supplied almost entirely by Fairway Creek and streamflow at SC3 (Stanley Creek below Fairway Creek) is essentially a measure of Fairway Creek.

Flow measurements have been made on the lower segment of Stanley at the USFS bridge below the confluence with Fairway Creek and near the mouth. Flows measured by WESTECH are as follows:

Date		(SC3) Stanley Ck. Below Fairway Ck. cfs	(SC4) Stanley Ck. Near Mouth cfs
April	20/77	34	31
April	29/77	35.5	38
May	25/77		46.4
June	26/77		50
July	20/77	45	51
October	25/77	28.5	30
February	10/78		42.7

The U.S. Geological Survey maintains a sampling station on Stanley Creek near the mouth. Flow data collected at this staiton is as follows:

Date		Flow (cfs)	Date		Flow (cfs)
July	14/76	147	April	28/77	34
August	17/76	96	May	5/77	44
September	21/76	66	June	22/77	50
October	18/76	53	July	20/77	47
November	11/76	49	August	23/77	35
December	13/76	39	September	19/77	35
January	11/77	36	November	28/77	35
February	8/77	33	February	21/78	53
March	20/77	33			

The gradient of Stanley Creek flattens noticeably as it flows towards Bull Lake. The main channel splits into two main channels, in a distributory delta or alluvial fan as it enters Bull Lake. During low-flow periods, the northern channel carries a flow, but during spring snowmelt and high flow periods, the southern channel is also used. As the main northern channel enters Bull Lake, it splits into many channels; parts of the stream are blocked by beaver dams, and evidence of past channel changes is obvious.

Fairway Creek

Fairway Creek originates from a group of springs located below the glacial moraine that blocks the upper Fairway Creek drainage and creates Spar Lake. Due to the water storage capability of Spar Lake, the springs that form Fairway Creek have a realtively constant flow. Fairway Creek extends approximately 1½ miles to its confluence with Stanley Creek and is the major source of water for the lower segment of Stanley Creek. Flow in Fairway Creek was not measured but is essentially the same as the flow in Stanley Creek below the confluence with Fairway Creek. Fairway Creek has a large sustained base flow due to the unusual hydrogeologic condition that creates its headwaters. Twilight Creek is a small tributary on the upper end of Fairway Creek and has a small drainage area. Twilight Creek was observed to be dry on several occasions during this investigation and has not developed a channel near the confluence of Fairway and Twilight Creeks.

Ross Creek

Ross Creek drains a large east-west trending valley located south of Mount Vernon. Headwaters of the stream, and its two main tributaries are located in steep mountainous terrain. The main stream flows in a gently sloping valley for about four miles before entering Bull Lake. Below the confluence of its two major forks, Ross Creek has a number of small ephemeral tributaries that have steep gradients and are in steep, rocky terrain. The Ross Creek drainage basin above the highway contains 23 square miles. The station is about one mile above Bull Lake in T28N, R33W, Section 8. Ross Creek supplies the major surface water flow into Bull Lake. The entire drainage basin contains little development and is in a conifer forest ecosystem.

The USGS maintains a water quality sample station on Ross Creek at the road bridge. (Figure). Flows measured by the USGS are as follows:

Date	Flow cfs	Date	Flow cfs
July 15/76	91	April 19/77	95
August 18/76	34	April 28/77	300
September 21/76	34	May 25/77	150
October 19/76	6.2	June 23/77	34
November 17/76	7.0	July 20/77	8.5
December 14/76	9.0	August 23/77	2.6
January 12/77	6.0	November 29/77	80
February 9/77	6.0	February 24/78	12

Flows in Ross Creek were measured 7 times during the ASARCO environmental baseline assessment and ranged from 18.6 to 1070 cfs (WADEVCO, 1976, p. 4-5).

In October, 1977, an examination of the stream channels downstream from the bridge revealed quite surprisingly that the stream, which was flowing 10 cfs at the bridge, was dry about one-half mile downstream from the bridge. Within a short distance, the entire stream percolated into the ground leaving a dry stream channel for a quarter mile toward Bull Lake.

The ASARCO south exploritory adit is located about one-half mile south of the summit of Mount Vernon. However, no additional mining related activity is proposed in the Ross Creek drainage.

Bull River

The Bull River begins just south of the low topographic divide separating the Bull Lake - Lake Creek system from the Bull River drainage. The Bull River flows southward about 17 miles to join the Clark Fork River. In the main valley, the Bull River meanders along a relatively flat valley. Tributaries to this river drain steep mountainous terrain. The drainage is sparcely populated, and the stream is unregulated.

The Bull River drainage area above the USGS gaging station near Noxon (near the Clark Fork River) is 139 square miles (USGS, 1976). Average discharge for the 1974-75 water year was 383 cfs and flows ranged from 73 to 2090 cfs. (USGS, 1976).

North Adit

Water from the ASARCO north exploratory adit exits the portal and cascades down the edge of the waste rock patio and quickly percolates into the rock rubble. Flow from this adit was measured several times with the following results:

Date		Flow (gpm)
May	11/76	100 (Estimated)
June	26/77	68.3
July	20/77	57
September	25/77	55.5
October	25/77	62.6

Flow from the adit measured in May of 1975 was increased by snowmelt entering the adit near the portal. The adit at the portal is timbered and melting snow was running and dripping through timbering and fractured rocks into the portal. Previous adit flows reported (WADEVCO, 1976, P. 6-1) range from 67 to 132 gpm for the period October 17, 1973, to October 15, 1975. It is expected that adit flow would be highest in the spring runoff and minimum in the fall and winter. Much of the adit water, however, may originate from fracture systems that are not recharged on an annual basis. The contribution of this water can be expected to decline over time as the system drains. When water is present in fractured rock systems, it generally drains at high rates when first encountered and then rapidly declines in flow. In the north adit a total equivalent heading advance of 1,546 feet of 7 X 9 foot drift was driven between September 11, 1967, and November 29, 1967. A total of 2,438 feet of diamond drilling was done within the ore body from October 1, 1967, to December 16, 1967.

Mine development will consist of a 3825 foot-long adit; ventilation adits and underground rooms. The room and pillar mining method will be used to extract the ore. Additional mining will surely encounter more groundwater resulting in variations in flow of water from the adit. It is difficult, if not impossible, to predict future flow rates, fluctuation in flow, and long-term flow trends. Temporary flows, many times the average flow, could be encountered during mining. The long-term flow rate could be several times the present flow rate, however, decrease of flow into mines as time progresses is common. It is possible that the long-term adit outflow may be similar to the present adit outflow.

In their application for an MPDES permit dated January 18, 1978, ASARCO stated:

> The new adit will have a larger cross-sectional area, length, and present the possibility of intercepting larger subterranean flows than those encountered to date; consequently, quantity restriction must be considerably larger than present measureable flows. The effluent description in this application assumes a daily average of 1,500 gpm with a maximum expected discharge of 2,500 gpm.

Maximum flows predicted by ASARCO appear to be largely based on the known flow history of the north adit development. Additional information of flow from the north adit was presented by WADEVCO (1976, p. 6-1 to 6-2) as follows:

Groundwater has been encountered in the process of drilling and developing the existing underground workings of the copper deposit. Most of the water encountered has been in the North Adit, in horizontal drill holes extending to the West from the adit and is flowing into the adit from the bedrock materials. During the 1973 field work maximum flow encountered from an individual drill hole amounted to 41 gpm which was entering the North Adit from a 480-foot horizontal hole. Measured flows from the North and South Adits are tabulated below:

Date	North Adit (gpm)
10-17-73	67
08-22-74	74
10-24-74	71
06-26-75	132
07-30-75	75
08-27-75	89
09-10-75	58
10-15-75	73

Maximum flow observed to date is 132 gpm from the North Adit in June, 1975. Source of the water encountered in the underground workings is infiltration from rainfall and snowmelt on the peak and flanks of Mount Vernon which overlie the ore body. The method of infiltration is through fractures in the rocks. Movement of groundwater through this fractured rock system would be fairly fast, thus the peak inflow would be expected to occur during the period of spring snowmelt. Entrance of large quantities of groundwater to the underground workings is not anticipated owing to the following factors:

(1) The relatively small areal extent of the ore body.

(2) The thin section of bedrock materials overlying the ore body.

(3) High runoff rates of rainfall and snowmelt due to the steep topography of the land surface overlying the ore body.

Due to the diversity of estimates of underground flows from the North Adit, a range of flow of 400 to 2500 gpm will be used to assess potential environmental effects.

South Adit

The South Adit was examined and found to have a very small flow of relatively good quality of water. Water exits the adit and flows along the waste dump and then infiltrates into the dump. A very small ephemeral drainage is present just west of the adit. If the adit flow were large the water would enter this drainage. Adit flow was estimated on July 20 and was one gpm. In October, 1977, there was no flow from the adit. Previous flows from the South Adit ranged from zero to 20 gpm. Most flows are small or zero (WADEVCO 1976, p. 6-1). From the appearance of the small stream channels exiting the adit, large flows from the adit have not occurred.

No additional development is planned in this adit as part of the mining plan, and no increase in adit flow is anticipated.

Camp Creek

Camp Creek is adjacent to the south end of the proposed Tailings Pond area and is tributary to Lake Creek. Camp Creek and its major tributary, Madge Creek, drain about 12 square miles of steep, mountainous area east of Lake Creek. Camp Creek has a steep gradient until it reaches the Lake Creek Valley where the last two miles have a relatively gentle gradient. Camp Creek has deposited coarse, unconsolidated alluvium in its lower reach. This permeable material allows substantial infiltration and, as a result, Camp Creek during periods of low flow, seeps into the streambed and is dry from a short distance west of Highway 202 to the confluence with Lake Creek.

Few flow measurements of Camp Creek have been made. From May to October of 1977, Camp Creek was observed to flow a few cubic feet per second at the highway and was dry at its confluence with Lake Creek. Peak flows in Camp Creek for a 100-year recurrence interval was estimated by WADEVCO (1976, p. 10-1) to be 1300 cfs.

Subsurface flow in Camp Creek probably contributes to surface water flow in Lake Creek. This contribution, however, probably is not major since there has been no distinct increase in flow measured on Lake Creek using stations above and below Camp Creek.

Keeler Creek

Keeler Creek enters Lake Creek about five miles downstream from Bull Lake and is the major tributary to Lake Creek between Stanley Creek and the Kootenai River.

Keeler Creek drains a large, rugged east-west trending valley west of Lake Creek. Little flow data is available for Keeler Creek, but it was observed to contribute a significant flow to Lake Creek and probably accounts for much of the increase in water flow in Lake Creek between the proposed Tailings Pond and the Kootenai River. On October 26, 1977, Keeler Creek was flowing 21.3 cfs.

Other Streams

A number of smaller streams enter Lake Creek including Falls, Felix, Iron, Copper, Twin, Porcupine, and Spring Creeks. These streams were observed to carry small flows of water during most of the year and the streams typically decline in flow or go dry as they approach Lake Creek. This apparently reflects infiltration into coarse alluvial materials bordering Lake Creek.

Project Water System

The project water system is described by the ASARCO corporation (1976, p. 23-24) as follows:

"The milling operation consumes the greatest volume of water. The majority of the water used in the milling process is captured and reused at the plant site. However, some 1,400 gpm are required to transport tailing to the tailing pond, which will be located some 6½ miles below the plant site, and some water is consumed at the mill.

Total process water in the milling circuit is estimated at 4,313 gpm. Concentrate and tailing thickener recycle will amount to 2,852 gpm, which requires make-up water from a fresh water supply or tailing pond of 1,461 gpm.

Tailing dam return water will vary from 25% to 50% of water going to the pond, or 365 to 730 gpm. This will require a fresh water supply of 731 to 1,096 gpm. The above numbers apply only to normal operation. During the first months after start-up and during periods of abnormal operation, there will be no tailing water return, so fresh water pumping capacity must be able to supply the full 1,461 gpm. Application for water permits will be prepared for 1,700 gpm from the wells located on Attachment D, plus potable water appropriated.

The quantity of water lost to seepage is very difficult to estimate. The 1,461 gpm of water going to the pond can probably be accounted for as follows:

Retained as pure water	292 gpm
Evaporation	0-146 gpm
Seepage	292-803 gpm
Decanted	365-730 gpm

The low quantity of seepage would be with some method of seepage control measures, such as pre-sliming, and the high quantity would be without any seepage control measures. Periods of heavy precipitation will increase the decanted water, while drought would decrease decanted water."

The seepage control measure of "pre-sliming" consists of placing the fine fraction (usually silt size and smaller) of the mine tailings on permeable areas to create a barrier to reduce water seepage. This is a commonly used practice which both reduces seepage and lowers "makeup" water requirements. The amount of water decanted (separated from solids) from the pond depends on evaporation which would decrease the amount of water in the pond and on precipitation which would add water to the pond.

Figure (   ) is a schematic diagram of major elements of the ASARCO water system.

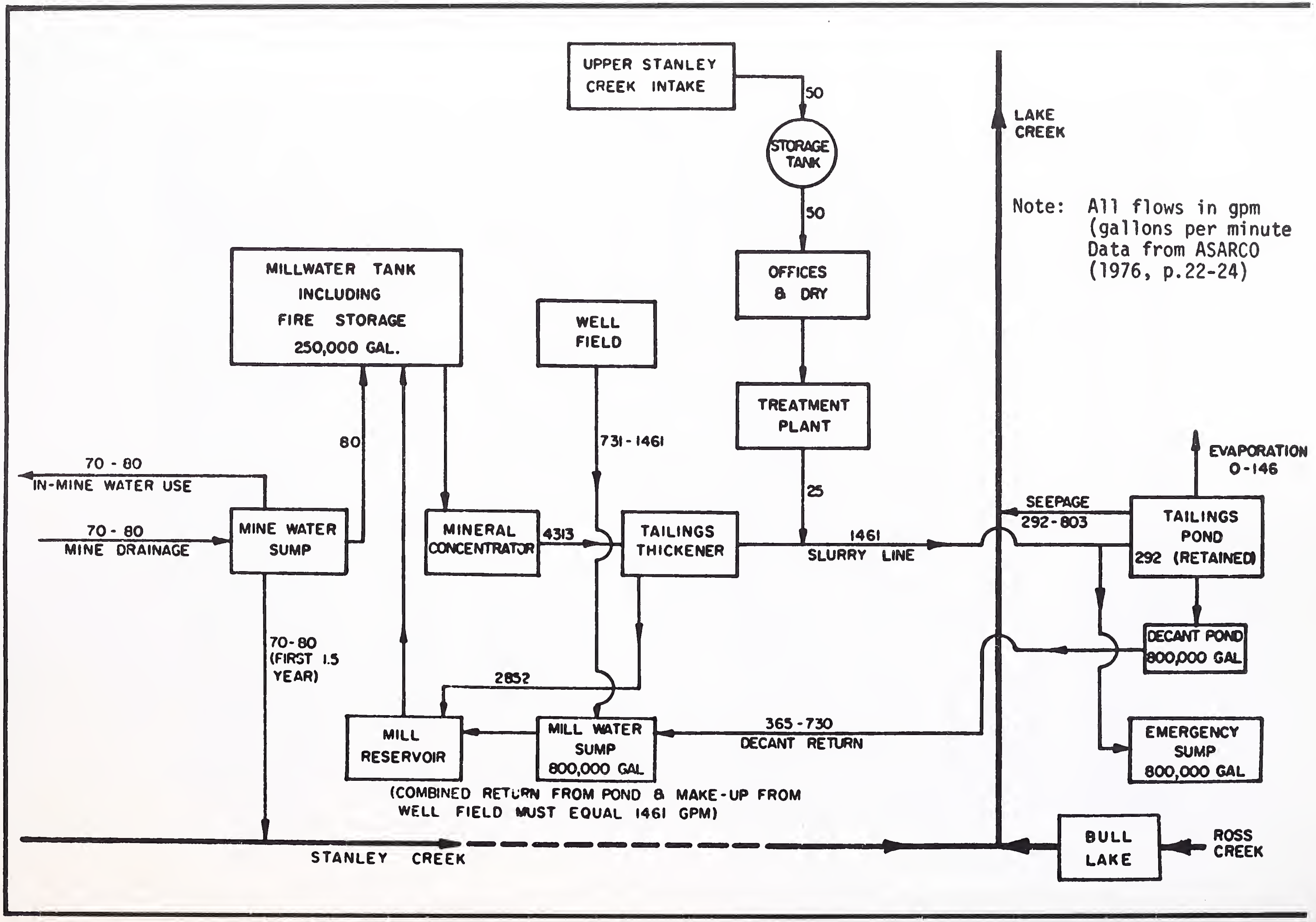

Figure Schematic Diagram of Proposed Operation Water Use System

APPENDIX G

Surface Water Quality Data for the Lake and Stanley Creek Drainages near Troy, Montana

STATION: ASARCO NORTH EXPLORATORY ADIT DISCHARGE (NAD) 29N 34W 35 AAB

Date Sampled	05/11/76	09/30/76	06/26/77	07/20/77	11/05/76	10/18/77	10/21/77
Sampling Agency	WQB	USFS	WESTECH	WESTECH	USFS	MF&G	MF&G
Temperature °C	-	4.0	5.0	7.0	4.5	-	9.5
Flow (CFS)	.22	-	.15	.13	-	.11	.11
Turbidity (JTU)	-	-	0.3	-	-	.1	.1
Specific Conductivity (umhos)	109.1	125.6	116.3	124.6	124.0	117.0	116.0
Dissolved Oxygen (mg/l)	-	-	-	-	-	-	-
pH units	7.93	7.67	8.10	7.90	8.00	8.30	8.10
ALK as $CaCO_3$ (mg/l)	46	32	60	61	54	-	-
HCO3 (mg/l)	56	39	73	74	66	-	-
CO3 (mg/l)	0	0	0	0	0	-	-
Total Nitrogen (mg/l as N)	-	-	<0.10	<0.05	-	-	-
Total NH3 N (mg/l as N)	-	-	<0.01	<0.01	-	-	-
Total Kjeldahl N (mg/l as N)	-	-	-	-	-	-	-
Total NO2 + NO_3 N (mg/l as N)	-	.26	.21	.25	.32	-	-
Total Phosphorus (mg/l as P)	-	-	.004	<0.001	-	-	-
CN (mg/l)	-	-	-	-	-	-	-
Hardness, Total (mg/l)	44	63	58	-	60	-	-
Non-Carb Hard (mg/l)	-	-	-	-	-	-	-
CA, Diss. (mg/l)	17.6	21.2	19.6	-	22	-	-
MG, Diss. (mg/l)	-	2.4	2.2	-	1.2	-	-
NA, Diss. (mg/l)	-	0.8	0.8	-	.7	-	-
SAR	-	0.0	0.0	-	0.0	-	-
K, Diss. (mg/l)	-	.21	.38	-	.4	-	-
Cl, Diss. (mg/l)	0.2	0.0	0.5	-	0.0	-	-
SO4, Diss. (mg/l)	1.5	27.0	3.2	-	2.6	-	-
F, Diss. (mg/l)	-	.66	<.05	-	-	-	-
AS, Diss. (mg/l)	-	-	<.001	-	.001	-	-
AS, TR (mg/l)	-	-	.001	-	-	-	-
Cd, Diss. (mg/l)	-	-	<.005	-	.001	-	-
Cd, TR (mg/l)	-	<0.005	< 0.005	-	-	-	-
Cu, Diss. (mg/l)	-	-	.02	-	.02	-	-

Cu, Total (mg/l)	-	-	-	.02	-	-	-
Cu, TR, (mg/l)	.05	<0.01	.02	-	-	-	-
Fe, Diss. (mg/l)	-	-	<.01	-	.08	-	-
Fe, TR (mg/l)	.09	<0.05	<0.01	-	-	-	-
Pb, Diss. (mg/l)	-	-	<.05	-	<.05	-	-
Pb, TR (mg/l)	<0.05	<0.05	<0.05	-	-	-	-
Mn, TR (mg/l)	<0.01	<0.01	-	-	-	-	-
ZN, Diss. (mg/l)	-	-	<.01	-	.02	-	-
Zn, Total (mg/l)	-	-	-	.01	-	-	-
ZN, TR (mg/l)	<0.01	<0.01	<0.01	-	-	<.01	<.01
Hg, Diss. (mg/l)	-	-	<0.0002	-	-	-	-
Hg, TR (mg/l)	-	-	<0.0002	-	-	-	-
Al, TR (mg/l)	-	-	<0.10	-	-	-	-
Al, Diss. (mg/l)	-	-	<.10	-	<.10	-	-
Ag, Total (mg/l)	-	<0.01	-	-	-	-	-
TDS (mg/l)	-	91.6	99.5	-	93.2	-	-
TSS (mg/l)	-	-	10.8	-	-	9.8	16.7
Oil and Grease (mg/l)	-	-	-	<1.	-	-	-
PO4 ASP (mg/l)	-	-	.002	<.001	.010	-	-

STATION: STANLEY CREEK BELOW NORTH EXPLORATORY ADIT (SC1) 29N 34W 26 DAC

Date Sampled	06/26/77	07/20/77	10/21/77	10/19/77
Sampling Agency	WESTECH	WESTECH	MF&G	MF&G
Temperature °C	9.0	8.0	10.0	-
Flow (CFS)	2.1	1.11	2	2
Turbidity (JTU)	0.3	-	.5	43.
Specific Conductivity (umhos)	57.4	-	67.0	66.0
Dissolved Oxygen (mg/l)	-	-	-	-
pH units	8.20	-	7.70	7.50
ALK As $CaCO_3$ (mg/l)	-	-	-	-
HCO3 (mg/l)	-	-	-	-
CO3 (mg/l)	-	-	-	-
Total Nitrogen (mg/l as N)	.47	-	-	-
Total NH3 N (mg/l as N)	<0.01	0	0	0
Total Kjeldahl N (mg/l)	-	-	-	-
Total NO2 + NO_3 N (mg/l)	.14	-	-	-
Total Phosphorus (mg/l as P)	.009	-	-	-
CN (mg/l)	-	-	-	-
Hardness, Total (mg/l)	-	-	-	-
Non-Carb Hard (mg/l)	-	-	-	-
Ca, Diss. (mg/l)	-	-	-	-
Mg, Diss. (mg/l)	-	-	-	-
Na, Diss. (mg/l)	-	-	-	-
SAR	-	-	-	-
K, Diss. (mg/l)	-	-	-	-
Cl, Diss. (mg/l)	-	-	-	-
SO4, Diss. (mg/l)	-	-	-	-
F, Diss. (mg/l)	-	-	-	-
AS, Diss. (mg/l)	-	-	-	-
AS, TR (mg/l)	-	-	-	-
Cd, Diss. (mg/l)	-	-	-	-
Cd, TR (mg/l)	-	-	-	-
Cu, Diss. (mg/l)	.01	-	-	-

Cu, Total (mg/l)	-	<0.01	-	-
Cu, TR, (mg/l)	-	-	-	-
Fe, Diss. (mg/l)	-	-	-	-
Fe, TR (mg/l)	-	-	-	-
Pb, Diss. (mg/l)	-	-	-	-
Pb, TR (mg/l)	-	-	-	-
Mn, TR (mg/l)	-	-	-	-
Zn, Diss. (mg/l)	<.01	-	-	-
Zn, Total (mg/l)	-	<0.01	-	-
Zn, TR (mg/l)	-	-	<0.01	<.01
Hg, Diss. (mg/l)	-	-	-	-
Hg, TR (mg/l)	-	-	-	-
Al, TR (mg/l)	-	-	-	-
Al, Diss. (mg/l)	-	-	-	-
Ag, Total (mg/l)	-	-	-	-
TDS (mg/l)	-	-	-	-
TSS (mg/l)	11.7	-	<11.1	59.4
Oil and Grease (mg/l)	-	<1.	-	-
PO4 ASP (mg/l)	.004	-	-	-

STATION: STANLEY CREEK NEAR FAIRWAY CREEK (SC3) 29N 34W 13 BADA

Date Sampled	03/21/77	04/20/77	04/29/77	07/20/77	10/18/77	10/21/77
Sampling Agency	WQB	WQB	USFS	WESTECH	MF&G	MF&G
Temperature ° C	5.5	6.0	6.5	7.0	6.7	9.0
Flow (CFS)	-	34	35.5	-	20	20
Turbidity (JTU)	-	-	.8	-	.1	.1
Specific Conductivity (umhos)	51.0	62.0	61.8	-	58.0	57.0
Dissolved Oxygen (mg/l)	-	-	-	-	-	-
pH units	7.70	-	-	-	7.40	7.80
ALK as $CaCO_3$ (mg/l)	27	-	-	-	-	-
HCO3 (mg/l)	33.	-	-	-	-	-
CO3 (mg/l)	0.	-	-	-	-	-
Total Nitrogen (mg/l as N)	-	-	-	-	-	-
Total NH3 N (mg/l as N)	-	-	-	-	-	-
Total Kjeldahl N (mg/l as N)	-	-	-	-	-	-
Total NO2 + NO_3 N(mg/l as N)	-	-	.11	-	-	-
Total Phosphorus (mg/l as P)	-	-	-	-	-	-
CN (mg/l)	-	-	-	-	-	-
Hardness, Total (mg/l)	36	-	-	-	-	-
Non-Carb Hard (mg/l)	-	-	-	-	-	-
CA, Diss. (mg/l)	10.5	-	-	-	-	-
Mg, Diss. (mg/l)	2.5	-	-	-	-	-
Na, Diss. (mg/l)	0.4	-	-	-	-	-
SAR	0.0	-	-	-	-	-
K, Diss. (mg/l)	0.0	-	-	-	-	-
Cl, Diss. (mg/l)	0.1	-	-	-	-	-
SO4 Diss. (mg/l)	14.0	-	-	-	-	-
F, Diss. (mg/l)	-	-	-	-	-	-
AS, Diss. (mg.l)	-	-	-	-	-	-
AS, TR (mg/l)	-	-	-	-	-	-
Cd, Diss. (mg/l)	-	-	-	-	-	-
Cd, TR (mg/l)	-	-	-	-	-	-
Cu, Diss. (mg/l)	<.01	-	-	-	-	-

Cu, Total (mg/l)	-	-	-	<0.01	-	-
Cu, TR, (mg/l)	<0.01	-	-	-	-	-
Fe, Diss. (mg/l)	<.05	-	-	-	-	-
Fe, TR (mg/l)	<0.05	-	-	-	-	-
Pb, Diss. (mg/l)	-	-	-	-	-	-
Pb, TR (mg/l)	-	-	-	-	-	-
Mn, TR (mg/l)	-	-	-	-	-	-
Zn, Diss. (mg/l)	<.01	-	<.01	-	-	-
Zn, Total (mg/l)	-	-	-	<0.01	-	-
Zn, TR (mg/l)	<0.01	-	-	-	<0.01	<0.01
Hg, Diss. (mg/l)	-	-	-	-	-	-
Hg, TR (mg/l)	-	-	-	-	-	-
Al, TR (mg/l)	-	-	-	-	-	-
Al, Diss. (mg/l)	-	-	-	-	-	-
Ag, TR (mg/l)	-	-	-	-	-	-
TDS (mg/l)	60.4	-	-	-	-	-
TSS (mg/l)	-	-	<11.	-	<11.1	<10.8
Oil and Grease (mg/l)	-	-	-	<1.0	-	-
PO4as P (mg/l)	-	-	-	-	-	-

STATION: STANLEY CREEK AT BRIDGE NEAR MOUTH (SC4) 29N 33W 7 DBDD

Date Sampled	04/20/77	04/29/77	05/25/77	06/26/77	07/20/77
Sampling Agency	WQB	USFS	USFS	WESTECH	WESTECH
Temperature ° C	-	7.0	6.0	10.0	7.0
Flow (CFS)	31	38	46.40	50	-
Turbidity (JTU)	.1	3.0	-	0.2	-
Specific Conductivity (umhos)	62.0	61.7	-	59.8	63.5
Dissolved Oxygen (mg/l)	-	-	-	-	-
pH units	-	-	-	8.20	7.30
ALK as $CaCO_3$ (mg/l)	-	-	-	-	32.
HCO3 (mg/l)	-	-	-	-	39
CO3 (mg/l)	-	-	-	-	0.
Total Nitrogen (mg/l as N)	<0.05	-	<0.05	.47	< 0.05
Total NH3 N (mg/l as N)	<0.01	<0.01	<0.01	<0.01	.01
Total Kjeldahl N (mg/l as N)	-	-	-	-	-
Total NO2 + NO_3 N(mg/l as N)	.06	.10	.10	.09	.13
Total Phosphorus (mg/l as P)	.004	<0.001	.002	.004	<0.001
CN (mg/l)	-	-	-	-	-
Hardness, Total (mg/l)	-	-	-	-	-
Non-Carb Hard (mg/l)	-	-	-	-	-
CA, Diss. (mg/l)	-	-	-	-	-
Mg, Diss. (mg/l)	-	-	-	-	-
Na, Diss. (mg/l)	-	-	-	-	-
SAR	-	-	-	-	-
K, Diss. (mg/l)	-	-	-	-	-
Cl, Diss. (mg/l)	-	-	-	-	-
S04 Diss. (mg/l)	-	-	-	-	-
F, Diss. (mg/l)	-	-	-	-	-
AS, Diss. (mg.l)	-	-	-	-	-
AS, TR (mg/l)	-	-	-	-	-
Cd, Diss. (mg/l)	-	-	-	-	-
Cd, TR (mg/l)	-	-	-	-	-
Cu, Diss. (mg/l)	-	-	-	<.01	-

Cu, Total (mg/l)	-	-	-	-	<0.01
Cu, TR, (mg/l)	-	-	-	-	-
Fe, Diss. (mg/l)	-	-	-	-	-
Fe, TR (mg/l)	-	-	-	-	-
Pb, Diss. (mg/l)	-	-	-	-	-
Pb, TR (mg/l)	-	-	-	-	-
Mn, TR (mg/l)	-	-	-	-	-
Zn, Diss. (mg/l)	<.01	<.01	-	<.01	-
Zn, Total (mg/l)	-	-	-	-	.01
Zn, TR (mg/l)	<0.01	<0.01	-	-	-
Hg, Diss. (mg/l)	-	-	-	-	-
Hg, TR (mg/l)	-	-	-	-	-
Al, TR (mg/l)	-	-	-	-	-
Al, Diss. (mg/l)	-	-	-	-	-
Ag, TR (mg/l)	-	-	-	-	-
TDS (mg/l)	-	-	-	-	-
TSS (mg/l)	<12.6	<11.	-	13.4	-
Oil and Grease (mg/l)	-	-	-	-	<1.0
PO4 as P (mg/l)	.004	-	-	<.001	.001

STATION: LAKE CREEK BELOW STANLEY CREEK (LC1) 29N 33W 6 DDAC

Date Sampled	04/20/77	05/04/77	06/26/77	07/20/77	05/13/75	08/20/75	07/07/76	10/07/76
Sampling Agency	WQB	USFS	WESTECH	WESTECH	USFS	USFS	USFS	USFS
Temperature o C	7.0	10.0	18.0	14.0	8.5	11.0	13.0	7.5
Flow (CFS)	142.	405.6	93.	65.	1097.	-	-	-
Turbidity (JTU)	.7	1.0	0.6	-	-	.95	1.5	-
Specific Conductivity (umhos)	65.7	67.5	62.4	-	-	-	54.2	86.4
Dissolved Oxygen (mg/1)	-	-	-	-	-	-	-	-
pH units	-	-	8.20	-	8.63	5.97	7.32	7.73
ALK as $CaCO_3$ (mg/1)	-	-	-	-	13	41	26	43
HCO3 (mg/1)	-	-	-	-	22	50	31.96	52.09
CO3 (mg/1)	-	-	-	-	0	0	.0	.0
Total Nitrogen (mg/1 as N)	.13	-	.49	<0.05	-	-	-	-
Total NH3 N (mg/1 as N)	<0.01	-	<0.01	.01	-	-	-	-
Total Kjeldahl N (mg/1 as N)	-	-	-	-	-	-	-	-
Total NO2 + NO_3 N(mg/1 as N)	.02	.03	.04	.08	-	-	.059	.070
Total Phosphorus (mg/1 as P)	.005	-	.004	.003	-	-	-	-
CN (mg/1)	-	-	-	-	-	-	-	-
Hardness, Total (mg/1)	-	-	-	-	22	37	24	42
Non-Carb Hard (mg/1)	-	-	-	-	4	0	-	-
CA, Diss. (mg/1)	-	-	-	-	6.8	10.1	7.0	12.0
Mg, Diss. (mg/1)	-	-	-	-	1.2	2.8	1.7	2.93
Na, Diss. (mg/1)	-	-	-	-	.9	1.0	.7	1.1
SAR	-	-	-	-	.1	.1	.1	.1
K, Diss. (mg/1)	-	-	-	-	.5	.5	.4	.5
Cl, Diss. (mg/1)	-	-	-	-	.3	1.4	.00	.45
SO4, Diss. (mg/1)	-	-	-	-	2.6	.3	3.03	1.99
F, Diss. (mg/1)	-	-	-	-	.0	.0	<.1	<.1
AS, Diss. (mg.1)	-	-	-	-	<.0020	-	-	-
AS, TR (mg/1)	-	-	-	-	-	-	-	-
Cd, Diss. (mg/1)	-	-	-	-	<.01	<.01	<.01	<.01
Cd, TR (mg/1)	-	-	-	-	-	-	-	-
Cu, Diss. (mg/1)	-	-	<.01	-	-	<.01	-	.01

Cu, Total (mg/l)	-	-	-	<0.01	-	-	-	-
Cu, TR, (mg/l)	-	-	-	-	-	-	-	-
Fe, Diss. (mg/l)	-	-	-	-	-	-	.13	.06
Fe, TR (mg/l)	-	-	-	-	-	-	-	-
Pb, Diss. (mg/l)	-	-	-	-	-	<.05	-	-
Pb, TR (mg/l)	-	-	-	-	-	-	-	-
Mn, TR (mg/l)	-	-	-	-	-	-	-	-
Zn, Diss. (mg/l)	<.01	<.01	<.01	-	<.01	<.01		.11
Zn, Total (mg/l)	-	-	-	<0.01	-	-	-	-
Zn, TR (mg/l)	<0.01	-	-	-	-	-	-	-
Hg, Diss. (mg/l)	-	-	-	-	<.0003	-	-	-
Hg, TR (mg/l)	-	-	-	-	-	-	-	-
Al, TR (mg/l)	-	-	-	-	-	-	-	-
Al, Diss. (mg/l)	-	-	-	-	-	.08	-	-
Ag, TR (mg/l)	-	-	-	-	-	-	-	-
TDS (mg/l)	-	-	-	-	41.8	73.2	49.7	77.1
TSS (mg/l)	<11.6	<12.	<11.1	-	-	-	-	-
Oil and Grease (mg/l)	-	-	-	2.	-	-	-	-
PO4as P (mg/l)	<.001	-	.001	.003	-	.02	.016	.013

STATION: LAKE CREEK ABOVE PORCUPINE CREEK (LC2) 30N 33W 30 DAA

Date Sampled	04/19/77	05/04/77	06/25/77
Sampling Agency	WQB	USFS	WESTECH
Temperature ° C	8.0	11.0	15.0
Flow (CFS)	-	-	87
Turbidity (JTU)	.9	2.0	0.4
Specific Conductivity (umhos)	96.0	60.6	67.2
Dissolved Oxygen (mg/l)	-	-	-
pH units	-	-	8.00
ALK as $CaCO_3$ (mg/l)	-	-	-
HCO3 (mg/l)	-	-	-
CO3 (mg/l)	-	-	-
Total Nitrogen (mg/l as N)	.15	-	.39
Total NH3 N (mg/l as N)	<0.01	-	<0.01
Total Kjeldahl N (mg/l as N)	-	-	-
Total NO2 + NO_3 N(mg/l as N)	.03	.07	.04
Total Phosphorus (mg/l as P)	.006	-	.004
CN (mg/l)	-	-	-
Hardness, Total (mg/l)	-	-	-
Non-Carb Hard (mg/l)	-	-	-
CA, Diss. (mg/l)	-	-	-
Mg, Diss. (mg/l)	-	-	-
Na, Diss. (mg/l)	-	-	-
SAR	-	-	-
K, Diss. (mg/l)	-	-	-
Cl, Diss. (mg/l)	-	-	-
SO4 Diss. (mg/l)	-	-	-
F, Diss. (mg/l)	-	-	-
AS, Diss. (mg.l)	-	-	-
AS, TR (mg/l)	-	-	-
Cd, Diss. (mg/l)	-	-	-
Cd, TR (mg/l)	-	-	-
Cu, Diss. (mg/l)	-	-	<.01

Cu, Total (mg/l)	-	-	-
Cu, TR, (mg/l)	-	-	-
Fe, Diss. (mg/l)	-	-	-
Fe, TR (mg/l)	-	-	-
Pb, Diss. (mg/l)	-	-	-
Pb, TR (mg/l)	-	-	-
Mn, TR (mg/l)	-	-	-
Zn, Diss. (mg/l)	<.01	<.01	<.01
Zn, Total (mg/l)	-	-	-
Zn, TR (mg/l)	<0.01	-	-
Hg, Diss. (mg/l)	-	-	-
Hg, TR (mg/l)	-	-	-
Al, TR (mg/l)	-	-	-
Al, Diss. (mg/l)	-	-	-
Ag, TR (mg/l)	-	-	-
TDS (mg/l)	-	-	-
TSS (mg/l)	<14.7	<11.	<9.4
Oil and Grease (mg/l)	-	-	-
PO4 as P (mg/l)	.002	-	<.001

STATION: KEELER CREEK AT BRIDGE ABOVE LAKE CREEK (KC1) 30N 33W 19 CCAC

Date Sampled	05/12/75	08/14/76	07/07/76	10/16/76	04/20/77
Sampling Agency	USFS	USFS	USFS	USFS	WQB
Temperature ° C	5.0	11.5	10.0	7.0	6.0
Flow (CFS)	517.11	50.21	-	-	85
Turbidity (JTU)	2.5	.5	.17	-	-
Specific Conductivity (umhos)	22.4	37.2	27.7	41.8	27.8
Dissolved Oxygen (mg/l)	-	-	-	-	-
pH units	6.06	5.94	7.33	7.39	7.30
ALK as $CaCO_3$ (mg/l)	5	16	13	19	-
HCO3 (mg/l)	6.	20.	15.86	23.30	-
CO3 (mg/l)	0.	0.	0.	0.	-
Total Nitrogen (mg/l as N)	-	-	-	-	<0.05
Total NH3 N (mg/l as N)	-	-	-	-	<0.01
Total Kjeldahl N (mg/l as N)	-	-	-	-	-
Total NO2 + NO_3 N(mg/l as N)	.5	.2	.047	.041	.11
Total Phosphorus (mg/l as P)	-	-	-	-	.002
CN (mg/l)	-	-	-	-	-
Hardness, Total (mg/l)	9	15	11	17	-
Non-Carb Hard (mg/l)	3	0	-	-	-
CA, Diss. (mg/l)	3.4	4.6	3.4	5.5	-
Mg, Diss. (mg/l)	.1	.9	.54	.82	-
Na, Diss. (mg/l)	1.	1.2	.9	1.2	-
SAR	.1	.1	.1	.1	-
K, Diss. (mg/l)	.4	.4	.3	.4	-
Cl, Diss. (mg/l)	.7	.6	.65	.60	-
SO4, Diss. (mg/l)	1.9	1.9	3.03	1.88	-
F, Diss. (mg/l)	.0	.0	<.1	<.1	-
AS, Diss. (mg.1)	<.0020	-	-	-	-
AS, TR (mg/l)	-	-	-	-	-
Cd, Diss. (mg/l)	<.01	<.01	<.01	<.01	-
Cd, TR (mg/l)	-	-	-	-	-
Cu, Diss. (mg/l)	<.01	<.01	-	<.01	-

Cu, Total (mg/l)	-	-	-	-	-
Cu, TR, (mg/l)	-	-	-	-	-
Fe, Diss. (mg/l)	-	-	.05	.03	-
Fe, TR (mg/l)	-	-	-	-	-
Pb, Diss. (mg/l)	<.05	<.05	-	-	-
Pb, TR (mg/l)	-	-	-	-	-
Mn, TR (mg/l)	-	-	-	-	-
Zn, Diss. (mg/l)	.01	<.01	-	.04	-
Zn, Total (mg/l)	-	-	-	-	-
Zn, TR (mg/l)	-	-	-	-	-
Hg, Diss. (mg/l)	<.0002	-	-	-	-
Hg, TR (mg/l)	-	-	-	-	-
Al, TR (mg/l)	-	-	-	-	-
Al, Diss. (mg/l)	.06	<.05	-	-	-
Ag, Total (mg/l)	-	-	-	-	-
TDS (mg/l)	21.5	37.0	30.5	41.1	-
TSS (mg/l)	-	-	-	-	-
Oil and Grease (mg/l)	-	-	-	-	-
P04 ASP (mg/l)	<.02	<.02	.010	.023	-

STATION: LAKE CREEK AT BRIDGE NEAR TROY (LC3) 30N 33W 5 ABA

Date Sampled	03/21/77
Sampling Agency	WQB
Temperature ° C	5.0
Flow (CFS)	-
Turbidity (JTU)	-
Specific Conductivity (umhos)	90.0
Dissolved Oxygen (mg/l)	-
pH units	7.70
ALK as $CaCO_3$ (mg/l)	54
HCO3 (mg/l)	66.
CO3 (mg/l)	0.
Total Nitrogen (mg/l as N)	-
Total NH3 N (mg/l as N)	<0.001
Total Kjeldahl N (mg/l as N)	-
Total NO2 + NO_3 N(mg/l as N)	.04
Total Phosphorus (mg/l as P)	-
CN (mg/l)	-
Hardness, Total (mg/l)	51
Non-Carb Hard (mg/l)	-
CA, Diss. (mg/l)	13.3
Mg, Diss. (mg/l)	4.3
Na, Diss. (mg/l)	1.6
SAR	0.1
K, Diss. (mg/l)	.3
Cl, Diss. (mg/l)	0.3
SO4, Diss. (mg/l)	0.5
F, Diss. (mg/l)	-
AS, Diss. (mg.l)	-
AS, TR (mg/l)	-
Cd, Diss. (mg/l)	-
Cd, TR (mg/l)	-
Cu, Diss. (mg/l)	<.01

Cu, Total (mg/l)	-
Cu, TR, (mg/l)	<0.01
Fe, Diss. (mg/l)	<.05
Fe, TR (mg/l)	.10
Pb, Diss. (mg/l)	-
Pb, TR (mg/l)	-
Mn, TR (mg/l)	-
Zn, Diss. (mg/l)	<.01
Zn, Total (mg/l)	-
Zn, TR (mg/l)	<0.01
Hg, Diss. (mg/l)	-
Hg, TR (mg/l)	-
Al, TR (mg/l)	-
Al, Diss. (mg/l)	-
Ag, TR (mg/l)	-
TDS (mg/l)	86.4
TSS (mg/l)	-
Oil and Grease (mg/l)	-
PO4 as P (mg/l)	.006

STATION: LAKE CREEK AT TROY (LC4) 31N 33W 18 CBBA

Date Sampled	04/21/77	06/25/77
Sampling Agency	WQB	WESTECH
Temperature ° C	-	15.0
Flow (CFS)	-	147
Turbidity (JTU)	-	0.7
Specific Conductivity (umhos)	76.0	83.6
Dissolved Oxygen (mg/l)	-	-
pH units	7.70	8.20
ALK as $CaCO_3$ (mg/l)	-	-
HCO3 (mg/l)	-	-
CO3 (mg/l)	-	-
Total Nitrogen (mg/l as N)	.08	.49
Total NH3 N (mg/l as N)	<0.01	<0.01
Total Kjeldahl N (mg/l as N)	-	-
Total NO2 + NO_3 N(mg/l as N)	.05	.03
Total Phosphorus (mg/l as P)	.004	.004
CN (mg/l)	-	-
Hardness, Total (mg/l)	-	-
Non-Carb Hard (mg/l)	-	-
CA, Diss. (mg/l)	-	-
Mg, Diss. (mg/l)	-	-
Na, Diss. (mg/l)	-	-
SAR	-	-
K, Diss. (mg/l)	-	-
Cl, Diss. (mg/l)	-	-
SO 4 Diss. (mg/l)	-	-
F, Diss. (mg/l)	-	-
AS, Diss. (mg.l)	-	-
AS, TR (mg/l)	-	-
Cd, Diss. (mg/l)	-	-
Cd, TR (mg/l)	-	-
Cu. Diss. (mg/l)	-	<.01

Cu, Total (mg/l)	-	-
Cu, TR, (mg/l)	-	-
Fe, Diss. (mg/l)	-	-
Fe, TR (mg/l)	-	-
Pb, Diss. (mg/l)	-	-
Pb, TR (mg/l)	-	-
Mn, TR (mg/l)	-	-
Zn, Diss. (mg/l)	-	<.01
Zn, Total (mg/l)	-	-
Zn, TR (mg/l)	-	-
Hg, Diss. (mg/l)	-	-
Hg, TR (mg/l)	-	-
Al, TR (mg/l)	-	-
Al, Diss. (mg/l)	-	-
Ag, TR (mg/l)	-	-
TDS (mg/l)	-	-
TSS (mg/l)	-	<13.
Oil and Grease (mg/l)	-	-
PO4 as P (mg/l)	-	<.001

STATION: KOOTENAI RIVER AT TROY (KR1) 31N 34W 1 DCC

Date Sampled	04/21/77	06/25/77
Sampling Agency	WQB	WESTECH
Temperature ° C	-	12.0
Flow (CFS)	-	3450.
Turbidity (JTU)	-	.08
Specific Conductivity (umhos)	227.9	260.7
Dissolved Oxygen (mg/l)	-	-
pH units	8.40	8.50
ALK as $CaCO_3$ (mg/l)	101	109
HCO3 (mg/l)	118.	129.
CO3 (mg/l)	2.	2.
Total Nitrogen (mg/l as N)	.12	.37
Total NH3 N (mg/l as N)	<0.01	<0.01
Total Kjeldahl N (mg/l as N)	-	-
Total NO2 + NO_3 N(mg/l as N)	.06	<.01
Total Phosphorus (mg/l as P)	.007	.008
CN (mg/l)	-	-
Hardness, Total (mg/l)	-	-
Non-Carb Hard (mg/l)	-	-
CA, Diss. (mg/l)	-	-
Mg, Diss. (mg/l)	-	-
Na, Diss. (mg/l)	-	-
SAR	-	-
K, Diss. (mg/l)	-	-
Cl, Diss. (mg/l)	-	-
SO4, Diss. (mg/l)	-	-
F, Diss. (mg/l)	-	-
AS, Diss. (mg.l)	-	-
AS, TR (mg/l)	-	-
Cd, Diss. (mg/l)	-	-
Cd, TR (mg/l)	-	-
Cu, Diss. (mg/l)	-	<.01

Cu, Total (mg/l)	-	-
Cu, TR, (mg/l)	-	-
Fe, Diss. (mg/l)	-	-
Fe, TR (mg/l)	-	-
Pb, Diss. (mg/l)	-	-
Pb, TR (mg/l)	-	-
Mn, TR (mg/l)	-	-
Zn, Diss. (mg/l)	-	<.01
Zn, Total (mg/l)	-	-
Zn, TR (mg/l)	-	-
Hg, Diss. (mg/l)	-	-
Hg, TR (mg/l)	-	-
Al, TR (mg/l)	-	-
Al, Diss. (mg/l)	-	-
Ag, TR (mg/l)	-	-
TDS (mg/l)	-	-
TSS (mg/l)	-	<9.5
Oil and Grease (mg/l)	-	-
PO4 as P (mg/l)	.005	<.001

STATION: ASARCO SOUTH EXPLORATORY ADIT DISCHARGE (SAD) 28N 33W 6 ACD

Date Sampled	09/30/76	07/20/77	11/05/76
Sampling Agency	USFS	WESTECH	USFS
Temperature ° C	6.5	7.0	5.0
Flow (CFS)	-	.002	-
Turbidity (JTU)	-	-	-
Specific Conductivity (umhos)	187.3	170.8	171.3
Dissolved Oxygen (mg/l)	-	-	-
pH units	7.28	7.70	7.6
ALK as $CaCO_3$ (mg/l)	75	85	78
HCO3 (mg/l)	91	103	95
CO3 (mg/l)	0	0	0
Total Nitrogen (mg/l as N)	-	<0.05	-
Total NH3 N (mg/l as N)	-	<0.01	
Total Kjeldahl N (mg/l as N)	-	-	-
Total NO2 + NO_3 N(mg/l as N)	.45	.50	.34
Total Phosphorus (mg/l as P)	-	.003	-
CN (mg/l)	-	-	-
Hardness, Total (mg/l)	95	-	86
Non-Carb Hard (mg/l)	-	-	-
CA, Diss. (mg/l)	27.3	-	25.4
Mg, Diss. (mg/l)	6.5	-	5.5
Na, Diss. (mg/l)	1.1	-	1.1
SAR	0.0	-	0.1
K, Diss. (mg/l)	.43	-	.7
Cl, Diss. (mg/l)	0.0	-	0.0
SO4, Diss. (mg/l)	20.0	-	4.4
F, Diss. (mg/l)	.12	-	-
AS, Diss. (mg.l)	-	-	.053
AS, TR (mg/l)	-	-	-
Cd, Diss. (mg/l)	-	-	<.001
Cd, TR (mg/l)	<0.005	-	-
Cu, Diss. (mg/l)	-	-	.04

Cu, Total (mg/l)	-	.07	-
Cu, TR, (mg/l)	.05	-	-
Fe, Diss. (mg/l)	-	-	.12
Fe, TR (mg/l)	<0.05	-	-
Pb, Diss. (mg/l)	-	-	<.05
Pb, TR (mg/l)	<0.05	-	-
Mn, TR (mg/l)	.03	-	-
Zn, Diss. (mg/l)	-	-	.17
Zn, Total (mg/l)	-	.01	-
Zn, TR (mg/l)	<0.01	-	-
Hg, Diss. (mg/l)	-	-	-
Hg, TR (mg/l)	-	-	-
Al, TR (mg/l)	-	-	-
Al, Diss. (mg/l)	-	-	<.10
Ag, Total (mg/l)	<0.01	-	-
TDS (mg/l)	147.4	-	132.7
TSS (mg/l)	-	-	-
Oil and Grease (mg/l)	-	<1.	-
PO4 as P (mg/l)	-	.003	.009

STATION: ROSS CREEK AT BRIDGE NEAR MOUTH (RC1) 28N 33W 8 ADA

Date Sampled	10/17/72	05/27/75	08/12/75	05/11/76	10/08/76	07/20/77
Sampling Agency	USFS	USFS	USFS	USFS	USFS	WESTECH
Temperature ° C	-	6.0	9.0	3.5	5.0	10.5
Flow (CFS)	-	213.63	20.40	213.	12.	15.
Turbidity (JTU)	-	.65	.5	-	-	-
Specific Conductivity (umhos)	50.4	41.9	46.1	32.1	52.2	-
Dissolved Oxygen (mg/1)	-	-	-	-	-	-
pH units	6.39	7.53	6.03	6.82	7.54	-
ALK as $CaCO_3$ (mg/1)	24	17	22	14	26	-
HCO3 (mg/1)	30	20	26	17.20	31.23	-
CO3 (mg/1)	0	0	0	.0	.0	-
Total Nitrogen (mg/1 as N)	-	-	-	-	-	-
Total NH3 N (mg/1 as N)	-	-	-	-	-	-
Total Kjeldahl N (mg/1 as N)	-	-	-	-	-	-
Total NO2 + NO_3 N(mg/1 as N)	-	.8	.4	.298	.095	-
Total Phosphorus (mg/1 as P)	-	-	-	-	-	-
CN (mg/1)	-	-	-	-	-	-
Hardness, Total (mg/1)	23	19	21	16	25	-
Non-Carb Hard (mg/1)	0	3	0	-	-	-
CA, Diss. (mg/1)	7.0	5.8	6.2	5.29	7.45	-
Mg, Diss. (mg/1)	1.5	1.3	1.3	.73	1.58	-
Na, Diss. (mg/1)	-	.4	.6	.4	.7	-
SAR	0	0	.1	0	.1	-
K, Diss. (mg/1)	-	.2	.3	.2	.3	-
Cl, Diss. (mg/1)	-	.1	.6	.5	.5	-
SO4, Diss. (mg/1)	6.0	1.0	.4	1.2	.55	-
F, Diss. (mg/1)	-	.0	.0	<.1	<.1	-
AS, Diss. (mg.1)	<.002	<.002	-	-	-	-
AS, TR (mg/1)	-	-	-	-	-	-
Cd, Diss. (mg/1)	<.001	<.01	<.01	<.01	<.01	-
Cd, TR (mg/1)	-	-	-	-	-	-
Cu, Diss. (mg/1)	<.001	<.01	<.01	-	.01	-

Cu, Total (mg/l)	-	-	-	-	-	<0.01
Cu, TR, (mg/l)	-	-	-	-	-	-
Fe, Diss. (mg/l)	-	-	-	.03	.23	-
Fe, TR (mg/l)	-	-	-	-	-	-
Pb, Diss. (mg/l)	<.005	<.05	<.05	-	-	-
Pb, TR (mg/l)	-	-	-	-	-	-
Mn, TR (mg/l)	-	-	-	-	-	-
Zn, Diss. (mg/l)	.01	.01	<.01		.39	-
Zn, Total (mg/l)	-	-	-	-	-	<0.01
Zn, TR (mg/l)	-	-	-	-	-	-
Hg, Diss. (mg/l)	-	<.0002	-	.3	-	-
Hg, TR (mg/l)	-	-	-	-	-	-
Al, TR (mg/l)	-	-	-	-	-	-
Al, Diss. (mg/l)	.0	.05	<.05	-	-	-
Ag, TR (mg/l)	-	-	-	-	-	-
TDS (mg/l)	44.2	34.5	40.6	29.1	46.9	-
TSS (mg/l)	-	-	-	-	-	-
Oil and Grease (mg/l)	-	-	-	-	-	<1.
P04 as P, TR (mg/l)	-	<.02	.03	.013	.016	-

APPENDIX H

1) Tentative Montana Department of Health and Environmental Sciences Authorization to Discharge Under the Montana Pollutant Discharge Elimination System

2) Water Quality Bureau Letters

MI

Permit No.: MT-0024538

MONTANA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

AUTHORIZATION TO DISCHARGE UNDER THE
MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with Section 69-4801, et. seq., R.C.M. 1947, MAC 16-2.14(10)-S14460 and MAC 16-2.14(10)-S14480,

ASARCO, Incorporated
P. O. Box 440
Wallace, Idaho 83873

is authorized to discharge from its mine adit at SE¼, Section 26, T. 29 N., R. 34 W., Lincoln County, Montana,

to receiving waters named Stanley Creek following percolation through the ground,

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on the date of the Department's approval of an acceptable chemical and biological monitoring program in Stanley Creek and an acceptable biological monitoring program on the discharge.

This permit and the authorization to discharge shall expire at midnight, February 28, 1983.

TENTATIVE

FOR THE MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

D. G. Willems, P. E., Chief
Water Quality Bureau
Environmental Sciences Division

Dated this day of

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS - SEE ANY ADDITIONAL REQUIREMENTS UNDER PART III.

During the period beginning on the effective date of this permit and lasting through February 28, 1983, the permittee is authorized to discharge from outfall(s) serial number(s)001.

Such discharges shall be limited and monitored by the permittee as specified below:

	Effluent Limitations				Self-Monitoring Requirements	
	Discharge Kg/day (lbs/day)		Concentration			
Parameter	Daily Avg.	Daily Max.	mg/1 Daily Avg.	mg/1 Daily Max.	Measurement Frequency	Sample Type
Flow-m^3/Day (MGD)	---	---	---	---	Daily	Instantaneous
Specific Conductivity, μmhos/cm	---	---	---	---	Daily	Grab
Nitrate & Nitrite (as N)	1/	---	---	---	Monthly	Grab
Ammonia (as N)	1/	---	---	---	Monthly	Grab
Total Kjeldahl Nitrogen (as N)	1.22(2.69)	---	---	---	Monthly	Grab
Orthophosphate (as P)	0.03(0.07)	---	---	---	Monthly	Grab
Total Phosphorus (as P)	0.06(0.14)	---	---	---	Monthly	Grab
Total Suspended Solids	---	---	30	45	Weekly	Grab
Total Aluminum	---	---	0.35	---	Monthly	Grab
Total Silver	---	---	0.025	---	Monthly	Grab
Total Manganese	---	---	0.04	---	Monthly	Grab
Total Cadmium	---	---	0.012	---	Monthly	Grab
Total Iron	---	---	0.10	---	Monthly	Grab
Total Copper	---	---	0.04	---	Monthly	Grab
Total Lead	---	---	0.12	---	Monthly	Grab
Total Zinc	---	---	0.035	---	Monthly	Grab

The concentration of oil and grease shall not exceed 20 mg/1 in any grab sample and shall be monitored weekly by grab sampling.

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored daily by grab sampling.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following locations(s): at the point of discharge from the adit, prior to disposal.

1/ The daily average discharge limitation for the sum of Nitrate plus Nitrite plus Ammonia shall be 1.20 Kg/day (2.64 lbs/day) as N. The limitation shall be determined by the sum of the measured values for NO_3 + NO_2 (as N) and NH_3 (as N) times the flow at the time of the sampling.

C. MONITORING AND REPORTING REQUIREMENTS

1. *Representative Sampling*

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. *Reporting*

Monitoring results obtained during the previous 1 month shall be summarized for each month and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed reporting period. The first report is due on the 28th day of the month following the effective date of this permit. Duplicate signed copies of these, and all other reports herein, shall be submitted to the Department and the Regional Administrator at the following addresses:

(a) Montana Department of Health
and Environmental Sciences
Water Quality Bureau
Capitol Station
Helena, Montana 59601

(b) Regional Administrator
U. S. Environmental Protection
Agency
Suite 900, 1860 Lincoln Street
Denver, Colorado 80295

Attention: Permits Branch

Note: If no discharge occurs during the reporting period, "no discharge" shall be reported, in letter form, to the above agencies.

3. *Definitions*

(a) The "Act" means the Federal Water Pollution Control Act Amendments of 1972, PL 92-500.

(b) The "Administrator" means the administrator of the United States Environmental Protection Agency.

(c) A "composite" sample, for monitoring requirements, is defined as a minimum of four (4) grab samples collected at equally spaced two (2) hour intervals and proportioned according to flow.

(d) For compliance purposes, the "daily average" discharge means the total discharge by weight during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of all the measured daily discharges by weight divided by the number of days during the calendar month when the measurements were made.

(e) For compliance purposes, the "daily maximum" discharge means the total discharge by weight during any calendar day. This limitation shall be determined by the analyses of a properly preserved composite sample composed of a minimum of grab samples collected at equally spaced two (2) hour intervals and proportioned according to flow at the time of sampling.

(f) For compliance purposes, the "daily average" concentration means the average concentration during a calendar month. Where less than daily sampling is required by this permit, the average concentration shall be determined by the summation of all measured daily samples divided by the number of days during the calendar month when the measurements were made.

(g) For compliance purposes, the "daily maximum" concentration shall be determined by the analysis of a properly preserved composite sample composed of a minimum of four (4) grab samples collected at equally spaced two (2) hour intervals and proportioned according to flow at the time of sampling.

(h) The "Department" means the Montana Department of Health and Environmental Sciences.

(i) The "EPA" means the United States Environmental Protection Agency.

(j) A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

(k) An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement using acceptable monitoring equipment.

(l) "Net" value, noted under Parameter, is calculated on the basis of the net increase of the individual parameter over the quantity of that same parameter present in the intake water measured prior to any contamination or use in the process of this facility. Any contaminants contained in any intake water obtained from underground wells shall not be adjusted for as described above and therefore shall be considered as process input to the final effluent. Limitations in which "net" is not noted are calculated on the basis of gross measurements, of each parameter in the discharge irrespective of the quantity or quality of those parameters in the intake waters.

(m) The "Regional Administrator" means the administrator of the region of EPA with jurisdiction over federal water pollution control activities in the state of Montana.

4. *Test Procedures*

Test procedures for the analysis of pollutants shall conform to regulations published in or subsequent revisions to the Federal Register, October 16, 1973, Vol. 38, Number 199, Part II. Sample collection and preservation shall be in accordance with the best methods technologically feasible, and shall be in a manner acceptable to the Department. (The EPA Region VIII Treatment and Preservation Guide should be consulted for acceptable sample collection and preservation techniques.)

All flow measuring and flow-recording devices used in obtaining data submitted in self-monitoring reports must indicate values within 10 percent of the actual flow being measured.

5. *Recording of Results*

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

(a) The exact place, date, and time of sampling;

(b) The dates the analyses were performed;

(c) The person(s) who performed the analyses;

(d) The analytical techniques or methods used; and

(e) The results of all required analyses.

6. *Additional Monitoring by Permittee*

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320-1). Such increased frequency shall also be indicated.

7. *Records Retention*

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Department or the Regional Administrator.

A. MANAGEMENT REQUIREMENTS

1. *Change in Discharge*

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit more frequently than or at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new MPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the Department of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. *Noncompliance Notification*

If, for any reason, the permittee does not comply with or will be unable to comply with any effluent limitation specified in this permit, the permittee shall provide the Department and the Regional Administrator with the following information, in writing, within five (5) days of becoming aware of such condition:

(a) A description of the discharge and cause of noncompliance; and

(b) The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. *Facilities Operation*

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. *Adverse Impact*

The permittee shall take all reasonable steps to minimize any adverse impact to state waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. *Bypassing*

Any diversion from or bypass of treatment or control facilities or systems necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Department and the Regional Administrator in writing of each such diversion or bypass.

2. *Transfer of Ownership or Control*

In the event of any change in control or ownership from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Department and the Regional Administrator.

3. *Availability of Reports*

Except for data determined to be confidential under Section 308 of the Act, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department and the Regional Administrator. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the imposition of criminal penalties as provided for in Section 69-4823 (6), R.C.M. 1947.

4. *Permit Modification*

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

(a) Violation of any terms or conditions of this permit;

(b) Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

(c) A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. *Toxic Pollutants*

Notwithstanding Part II, B-4 above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. *Civil and Criminal Liability*

Except as provided in permit conditions on "Bypassing" (Part II, A-5) and "Power Failures" (Part II, A-7), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. *Oil and Hazardous Substance Liability*

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. *Property Rights*

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

9. *Severability*

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

OTHER REQUIREMENTS PART III MI

1. *Reapplication*

If the permittee desires to continue to discharge beyond the expiration date of this permit, he shall reapply, in writing, to the Department at least 180 days prior to the expiration date of this permit.

2. *Additional Monitoring Requirements*

(a) Effluent Biological Monitoring

(i) In Situ Fish Bioassay

For the duration of the discharge, the permittee shall conduct one in situ 96-hour fish bioassay in each of the following three-month periods: January-March, April-June, July-September, October-December. The bioassay shall use effluent water before it percolates underground. Live cars shall be used to house the test fish, which shall be either rainbow or cutthroat trout, depending upon availability. Prior to this permit becoming effective, the permittee shall submit to the Department an acceptable procedure for conducting the above fish bioassays. Such procedure shall contain the details on the methodology of the bioassays. Results of the fish bioassays shall be reported in terms of percent survival at 96 hours.

(ii) Algal Assay

For the duration of the discharge, the permittee shall conduct one algal assay in each of the following three-month periods: January-March, April-June, July-September, October-December. The algal assay shall be performed as prescribed by the U. S. Environmental Protection Agency ("Algal Assay Procedure: Bottle Test," National Eutrophication Research Program, Pacific Northwest Water Laboratory, Corvallis, Oregon, August, 1971), using effluent water before it

(ii) Algal Assay (continued)

percolates underground. The assay water shall be analyzed for NH_3-N, NO_3 + NO_2 - N, ortho PO_4 - P and total phosphorus.* Each assay shall be run in triplicate and the results shall be reported in terms of milligrams per liter maximum yield dry weight of the test alga.

*These will be analyzed monthly as part of the permittee's effluent monitoring requirements.

(b) Instream Biological and Chemical/Physical Monitoring

For the duration of this permit, the following monitoring shall be conducted by the permittee on Stanley Creek at one station upstream and one station downstream of the point where the effluent enters the creek. The precise location of the two stations shall be determined jointly by the permittee and the Department. Such monitoring locations shall be approved by the Department prior to this permit becoming effective.

(i) Biological Monitoring

In situ fish bioassays and algal assay bottle tests shall be performed as outlined in sections 2(a)(i) and 2(a)(ii) above.

(ii) Chemical/Physical Monitoring

At the time of the biological monitoring specified in 2(b)(i) above, the permittee shall take grab samples for the following: NH_3 - N, NO_3 + NO_2 - N, total Kjeldahl Nitrogen, ortho PO_4 - P, total phosphorus, total iron, total copper, total zinc, total lead, total aluminum, total manganese, total cadmium, total silver, specific conductance, and pH. Test procedures shall follow those prescribed in Part I (c)(4) of this permit. Instantaneous streamflow shall be measured at the time of biological and chemical/physical monitoring.

ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
SUITE 900, 1860 LINCOLN STREET
DENVER, COLORADO 80203

December 13, 1976

Mr. Abe Horpsted
Water Quality Bureau
Montana Department of Health and
Environmental Sciences
Helena, Montana 59601

Dear Abe:

Several weeks ago you requested, by phone, any information that might be available on the toxicities to aquatic life of four chemicals which are to be used in copper ore processing near Troy, Montana. The chemicals you listed were glycomethyl ether, terpineol, potassium amyl xanthate and sodium bi-sulfate.

A search of the literature at the lab revealed a minimum amount of pertinent information on the various chemicals. However, I conferred with Jim Rouse of NEIC and he loaned me a publication that may answer most of your questions. The report is titled "Use, Characteristics and Toxicity of Mine-Mill Reagents in Ontario", written by John R. Hawley, Special Projects Section: Mining Industrial Wastes Branch, Ontario Ministry of the Environment, 135 St. Clair Ave. West, Toronto, Ontario, Canada. Publication date is 1972. The following data has been abstracted from the report.

> Terpineol and glycomethyl ether are both used as frothing agents. Terpineol (otherwise known as pine oil, alpha-terpineol, or cyclic terpine alcohol) appears to be relatively non-toxic. Tests with bluegills indicated a 48 hour TL_m of 69 ppm. (All test results reported are not final and indicate relative toxicities only.)
>
> The material tested was produced by the Hercules Company under the trade names "Yarmor F and Yarmor 350 (although the chemical tested may be non-toxic it may be similar to phenol in tainting properties).
>
> Glycomethyl ether was listed as polypropylene glycolmethyl ethers manufactured by Dow Co. as Dowfroth. The Cyanamid Co. may manufacture a similar compound under the trade name Aerofroth. The toxicity of Dowfroth to blue gills was greater than 1000 ppm v./v. (or relatively non-toxic). Some Aerofroth compounds were moderately toxic with the lowest concentrations ranging from 10-100 ppm v./v. for Aerofroth 77. The Water Quality Criteria (Blue book) lists quaiacol (another name for glycomethyl ether) as a flavor producing agent with 0.1 ppm as the highest concentration that does not impair flavor.

> Potassium amyl xanthate is a collector which is completely water soluble and relatively stable. Commercial products based on potassium amyl xanthate were listed as Z-6 (Dow Co.), Aero Xanthate 350 (Cyanamid Co.) and CX-51 (Chemcell Co.). Toxicities reported ranged from 0.1 to 1.0 ppm w/v for Daphnia magna to 18 to 180 ppm w/v P. promelas.

The compound sodium bi-sulfate was not listed. However, Rouse thought it would probably be used as a pyrite depressant which would be relatively non-toxic.

According to Rouse the milling process should produce a relatively non-toxic, alkaline waste. Potential problems may occur when the waste filters through the substrate. As the waste seeps underground it will probably become acidic and may carry significant quantities of zinc and cadmium. You may want to monitor for various forms of zinc and cadmium as well as acidic conditions. Jim has some suggestions on locations of sampling wells that you might want the company to install as part of the permit conditions.

If you have additional questions I would suggest that you contact Jim at NEIC, phone # 234-4658. If I can be of further assistance let me know.

Cordially yours,

Loys P. Parrish

Loys P. Parrish
Aquatic Biologist
Technical Investigations Branch
Surveillance & Analysis Division

cc: Mike Etchingham

Office Memorandum • **STATE DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES**

TO : Jim Rasmussen **DATE:** October 4, 1977

FROM : Mike Pasichnyk M.P.

SUBJECT : Investigation of the ASARCO Mining Activity near Troy, Montana

An investigation was made September 28, 1977 into a reported water discharge from the ASARCO mining activity near Troy, Montana. The report was made by Steve Loken, hydrologist for the Kootenai National Forest in Libby. The discharge originated from a hole being drilled for exploratory purposes at upper Stanley Creek.

At the drilling site on September 28, I met with the operator of the drilling operation, Russ Carlson. During my visit, no discharge was occuring. However, according to Mr. Carlson; when the drilling is stopped in the evening, the discharge will start to drain from the drill hole. When discharging, the drill hole water enters directly into Stanley Creek.

In the creek just below the drilling site, a fine light colored sediment was observed in the creek bottom. The extremely fine texture of this sediment was similar to the fines from the drill hole. This sediment was not seen in the creek immediately above the drill site. An oil or gasoline sheen was observed on the water's surface in backwater pools of the creek below the drill site. This oil probably resulted from machinery used for drilling.

As no discharge occured at the time of this investigation; Steve Loken agreed to collect samples of the discharge later in the evening. This sampling was accomplished early Friday morning. These samples were mailed to Helena and received by me on Monday, October 3, 1977. Steve estimated the flow of the discharge at about 10 gpm.

Steve reported that the drilling at the sampling site will soon be discontinued. ASARCO probably plans to move to a new site in order to continue their exploration.

After I conferred with Jim Brown of the Water Quality Bureau; he suggested the Bureau take appropriate enforcement action on this matter.

November 16, 1977

Mr. Jack P. Bingham, Superintendent
Troy Project
Northwestern Mining Department
ASARCO, Inc.
P. O. Box 440
Wallace, ID 83873

RE: Unpermitted Discharges to State Waters

Dear Mr. Bingham:

The Department has recently received complaints concerning your exploratory work near Troy, Montana. Mr. Steve Loken, Kootenai National Forest, and Mr. Mike Pasichnyk of this Department have reported that as a result of ASARCO's mining activities, wastes have been placed and discharged into or near the Upper Stanley Creek drainage.

Section 69-4806 of the Montana Laws Regarding Water Pollution state in part, the following:

> "It is unlawful to:
>
> (1) cause pollution as defined in section 69-4802(s), R.C.M. 1947, of any state waters or to place or cause to be placed any wastes in a location where they are likely to cause pollution of any state waters;
>
> (2) carry on any of the following activities without a current permit from the department:
>
> > (c) discharge sewage, industrial wastes, or other wastes into any state waters;"

Further violations will leave the Department with no other choice, but to seek further enforcement action.

If ASARCO plans to do any further exploratory work which may result in a discharge of wastes into state waters, an MPDES permit must be obtained 180 days prior to commencement of the discharge.

(continued)

Please feel free to contact the Department if you have any questions concerning the above. MPDES permit applications can be obtained from this office.

Sincerely,

James E. Rasmussen
Public Health Engineer
Water Quality Bureau

JER:nmn

cc: EPA - Permits Branch
John North, State Lands
Legal Branch, DHES
Brian L. Shovers, 110 North Ave. E., Missoula
Steve Loken, Kootenai National Forest, U.S.F.S., Libby

APPENDIX I

Algal Assay Results

ALGAL ASSAY RESULTS

Water Source Lake Creek below Stanley Creek (LC1)

Background Nutrients mg/1 NH$_3$ < .01 NO$_3$ + NO$_2$ .02 TS1N .02 TP .005 OP < .001

Date Collected 4/20/77 Date Received 4/22/77

Date Test Started 4/29/77 Date Completed 5/9/77

Preparation of Water

Spikes	mg/1 Total N	mg/1 Total P	mean cells/1	S	Max. Yield Dry Wt. mg/1	Day Max. Yield Reached	Theoretical Max. Yield
Control	.02	<.001	$4.7x10^6$	$1.0x10^6$	.171	7	<0.10
.10P	.02	.100	$4.7x10^7$	$1.3x10^7$	1.26	7	0.76
.50N	.52	<.001	$4.8x10^6$	$1.1x10^6$	.181	7	<0.10
.10P + .50N	.52	.100	$2.5x10^7$	$2.9x10^6$	.844	7	19.80
Control + 1 EDTA	.02	<.001	$3.9x10^6$	$1.8x10^5$	.167	7	<0.10
.10P + .50N + 1 EDTA	.52	.100	$2.3x10^8$	$1.6x10^7$	5.06	7	19.80
.10P + .50N + Micro Nutrients	.52	.100	$2.5x10^8$	$9.3x10^7$	5.96	7	19.80

ALGAL ASSAY RESULTS

Water Source Lake Creek Below Stanley Creek (LC1)

Background Nutrients mg/l NH_3 .01 $NO_3 + NO_2$ .08 TSIN .09 TP .003 OP .003

Date Collected 7/20/77 Date Received 7/22/77

Date Test Started 10/7/77 Date Completed 10/19/77

Preparation of Water Kjeldahl N=<.05

Spikes	mg/l Total N	mg/l Total P	mean cells/l	S	Max. Yield Dry Wt. mg/l	Day Max. Yield Reached	Theoretical Max. Yield
Control	.09	.003	$.68\text{x}10^7$	$1.0\text{x}10^6$	.21	4	0.30
.10P + .50N	.59	.103	$8.5\text{x}10^7$	$4.2\text{x}10^6$	3.01	7	22.40
.10P + .50N + Micronutrients	.59	.103	$3.1\text{x}10^8$	$1.2\text{x}10^7$	9.15	7	22.40

ALGAL ASSAY RESULTS

Water Source Stanley Creek at Bridge near mouth (SC4)

Background Nutrients mg/l NH_3 <.01 $NO_3 + NO_2$ .06 TSIN .06 TP .004 OP .004

Date Collected 4/20/77 Date Received 4/22/77

Date Test Started 4/29/77 Date Completed 5/9/77

Preparation of Water

Spikes	mg/l Total N	mg/l Total P	mean cells/l	S	Max. Yield Dry Wt. mg/l	Day Max. Yield Reached	Theoretical Max. Yield
Control	.06	.004	5.4×10^{6}	3.6×10^{5}	.188	7	0.40
.10P	.06	.104	9.5×10^{6}	1.3×10^{6}	.244	7	2.30
.50N	.56	.004	4.5×10^{6}	8.3×10^{5}	.159	7	0.40
.10P + .50N	.56	.104	6.3×10^{6}	2.3×10^{6}	.195	7	21.30
Control + 1 EDTA	.06	.004	6.3×10^{6}	2.9×10^{5}	.270	7	0.40
.10P + .50N + 1 EDTA	.56	.104	3.7×10^{8}	1.4×10^{7}	9.44	7	21.30
.10P + .50N + Micro Nutrients	.56	.104	3.8×10^{8}	1.3×10^{7}	11.86	7	21.30

ALGAL ASSAY RESULTS

Water Source Stanley Creek at Bridge near Mouth (SC4)

Background Nutrients mg/1 NH_3 .01 NO_3 + NO_2 .10 TSIN .10 TP .002 OP .002

Date Collected 5/25/77 Date Received 6/6/77

Date Test Started 10/7/77 Date Completed 10/19/77

Preparation of Water Kjeldahl N = .05

Spikes	mg/1 Total N	mg/1 Total P	mean cells/1	S	Max. Yield Dry Wt. mg/1	Day Max. Yield Reached	Theoretical Max. Yield
Control	.10	.002	$1.1x10^{7}$	$3.6x10^{6}$	.31	4	0.20
.10P + .50N	.60	.102	$9.4x10^{7}$	$31x10^{6}$	4.03	12	22.80
.10P + .50N + Micro Nutrients	.60	.102	$2.7x.10^{8}$	$1.2x10^{6}$	8.16	7	22.80

ALGAL ASSAY RESULTS

Water Source Stanley Creek Below Fairway Creek (SC3)

Background Nutrients mg/l NH_3 $NO_3 + NO_2$ TS1N ca.007 TP OP ca.003

Date Collected 7/20/77 Date Received 7/22/77

Date Test Started 10/7/77 Date Completed 10/19/77

Preparation of Water No Nutrient Bottle Collected

Spikes	mg/l Total N	mg/l Total P	mean cells/l	S	Max. Yield Dry Wt. mg/l	Day Max. Yield Reached	Theoretical Max. Yield
Control	ca.007	ca.003	$.87 \times 10^7$	1.4×10^6	.28	4	-
.10P + .50N	.50 (0.507)	.10 (1.103)	8.0×10^7	6.2×10^5	2.89	12	19.4
.10P + .50N + Micro-Nutrients	.50 (0.507)	.10 (0.103)	3.5×10^8	2.8×10^6	10.16	7	19.4

ALGAL ASSAY RESULTS

Water Source Lake Creek above Porcupine Creek (LC2)

Background Nutrients mg/1 NH_3 .03 $NO_3 + NO_2$ .03 TS1N .06 TP .006 OP .002

Date Collected 4/19/77 Date Received 4/22/77

Date Test Started 4/29/77 Date Completed 5/9/77

Preparation of Water

Spikes	mg/1 Total N	mg/1 Total P	mean cells/1	S	Max. Yield Dry Wt. mg/1	Day Max. Yield Reached	Theoretical Max. Yield
Control	.06	.002	$5.6x10^5$	$3.8x10^6$	.020	5	0.20
.10P	.06	.102	$2.7x10^7$	8×10^6	.855	7	2.30
.50N	.56	.002	$3.7x10^6$	$3.4x10^5$	.142	7	0.20
.10P + .50N	.56	.102	$1.5x10^8$	$2.4x10^7$	3.80	7	21.30
Control + 1 EDTA	.06	.002	$5.6x10^6$	$2.6x10^6$	.227	7	0.20
Control + .10P + .50N + 1 EDTA	.56	.102	$2.0x10^8$	$1.7x10^7$	4.56	7	21.30
.10P + .50N + Micro Nutrients	.56	.102	$1.8x10^8$	$2.4x10^7$	5.04	7	21.30

ALGAL ASSAY RESULTS

Water Source Lake Creek Above Procupine Creek (LC2)

Background Nutrients mg/l NH_3 .02 $NO_3 + NO_2$ .13 TSIN .15 TP .003 OP $<$.001

Date Collected 7/20/77 Date Received 7/22/77

Date Test Started 10/7/77 Date Completed 10/19/77

Preparation of Water Kjeldahl N=$<$.05

Spikes	mg/l Total N	mg/l Total P	mean cells/l	S	Max. Yield Dry Wt. mg/l	Day Max. Yield Reached	Theoretical Max. Yield
Control	.15	.003	8.5×10^6	4.3×10^5	.26	4	0.30
.10P + .50N	.55	.103	1.5×10^8	3.9×10^7	5.29	12	20.90
.10P + .50N + Micronutrients	.55	.103	3.1×10^8	4.6×10^6	8.90	7	20.90

ALGAL ASSAY RESULTS

Water Source Kootenai River @ Troy (KR1)

Background Nutrients mg/l NH_3 .01 $NO_3 + NO_2$ .06 TS1N .07 TP .007 OP .005

Date Collected 4/21/77 Date Received 4/22/77

Date Test Started 4/29/77 Date Completed 5/9/77

Preparation of Water

Spikes	mg/l Total N	mg/l Total P	mean cells/l	S	Max. Yield Dry Wt. mg/l	Day Max. Yield Reached	Theoretical Max. Yield
Control	.06	.005	5×10^6	8.7×10^5	.204	7	0.50
.10P	.06	.105	7.4×10^7	13×10^6	2.25	7	2.30
.50N	.56	.005	4.3×10^6	6.6×10^6	.182	7	0.50
.10P + .50N	.56	.105	1.9×10^8	1.7×10^7	5.55	7	21.30
Control + 1 EDTA	.06	.005	6.2×10^6	3.0×10^5	2.52	7	0.50
.10P + .50N + 1 EDTA	.56	.105	3.0×10^8	2.6×10^7	13.90	7	21.30
.10P + .50N + Micro Nutrients	.56	.105	3.7×10^8	1.5×10^8	16.78	7	21.30

ALGAL ASSAY RESULTS

Water Source Kootenai River at Troy (KR1)

Background Nutrients mg/1 NH_3 < .01 $NO_3 + NO_2$ .13 TS1N .13 TP .003 OP .001

Date Collected 7/20/77 Date Received 7/22/77

Date Test Started 10/7/77 Date Completed 10/19/77

Preparation of Water Kjeldahl N=<.05

Spikes	mg/1 Total N	mg/1 Total P	mean cells/1	S	Max. Yield Dry Wt. mg/1	Day Max. Yield Reached	Theoretical Max. Yield
Control	.13	.003	8.9×10^6	9.1×10^5	.27	4	0.30
.10P + .50N	.68	.103	8.0×10^7	6.2×10^5	2.89	12	25.80
.10P + .50N + Micronutrients	.68	.103	2.8×10^8	3.3×10^6	8.09	10	25.80

APPENDIX J

Stearns-Roger (1975) Plankton Data

SAMPLING PROGRAM I AND II PLANKTON

Organisms	BULL LAKE								LAKE CREEK																STANLEY CREEK								ROSS CREEK			
	Station 5						Station 6		Station 3								Station 4								Station 2								Station 10		Station 11	
	9/24/74 930 hrs.				7/23/74		7/23/74		9/22/74 1815 hrs.						7/21/74		9/23/74 1030 hrs.						7/20/74		9/22/74 1520 hrs.						7/20/74		7/19/74		7/19/74	
	conc.		unconc.		tow		tow		conc.		unconc.		tow		tow		conc.		unconc.		tow		tow		conc.		unconc.		tow		tow		tow		tow	
	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter	%	#/100 liter
Chlorophyta	3.46	10,378	1.83	176,136	2.04		3.05		12.71	444.44	0.22	488	31.03		6.05	25.39	8.01	385.11	2.35	9,763	26.62		11.88	30.71	7.1	133			4.37				2.08	0.57	2.59	1.20
Ulothrix			0.05	4,296					4.87	170.44			17.54		0.17	0.70	2.63	126.00			8.98		0.83	2.14	2.3	45			1.31							
Spyrogyra							0.22		0.64	22.22			0.20		0.58	2.43	0.46	22.22			1.36		0.83	2.14	0.4	7			0.66				2.08	0.57		
Microspora									0.22	7.33			0.59				0.15	7.33			1.67				0.4	7										
Oedogonium	3.46	10,378	1.76	169,692	2.04		0.65		0.64	22.22	0.22	488	2.26		4.39	18.43	2.00	96.22	2.23	9,275	3.34		8.02	20.71	1.6	30			1.96							
Mougeotia									0.42	14.89			1.57		0.25	1.04	0.31	14.89			3.34															
Rhizoclonium			0.02	2,148					4.66	162.89			6.50		0.08	0.35	0.31	14.89			3.34		1.10	2.86											0.66	0.40
Bulbochaeta							0.22						0.10		0.08	0.35	0.15	7.33			0.21															
Volvocaceae																													0.22							
Schizogonium													0.10																							
Leptosira																																			1.73	0.80
Zygnema							1.96														0.21															
Cosmarium									0.84	29.56			1.18								0.10				2.0	37										
Staurastrum													0.10						0.12	488	0.42				0.4	7										
Closterium									0.42	14.89					0.42	1.74	2.00	96.22			3.65		1.10	2.86					0.22							
Pediastrum													0.89		0.08	0.35																				
Pyrrophyta	0.50	1,489	0.02	2,148	1.02				0.42	14.89	0.22	488	2.46				0.15	7.33	0.12	488	9.08		0.28	0.71												
Ceratium	0.50	1,489	0.02	2,148	1.02				0.42	14.89	0.22	488	2.46				0.15	7.33	0.12	488	9.08		0.28	0.71												
Chrysophyta	87.13	260,733	98.02	9,468,384	79.60		53.16		30.30	1,059.33	99.34	217,729	28.77		80.03	336.00	28.20	1,355.56	97.30	404,703	42.80		60.22	155.71	36.9	696	96.00	12,888	21.66		4.81	0.57	2.08	0.57	4.31	2.00
Tabellaria	35.13	105,178	8.61	831,276	74.50		48.59		3.60	126.00	13.14	28,803	5.81		65.86	276.52	10.94	526.00	12.44	51,747	16.18		36.19	93.57	10.2	193	4.00	268	0.88							
Gomphonema	0.50	1,489							11.44	400.00	0.45	976	11.03		0.17	0.70	1.23	59.33	0.23	976	4.18		0.28	0.71			2.00	268								
Asterionella	3.46	10,378	0.13	73,032			0.65		1.70	59.33			0.39				1.09	51.78	0.59	2,441	2.82				0.4	7										
Fragilaria	5.94	17,778	3.89	375,900	5.10		2.83		2.12	74.00	3.79	8,299	9.57		13.50	56.70	1.54	74.00	2.93	12,205	13.57		22.37	57.86	4.7	89	46.00	6,176	0.22		0.48	0.29	1.04	0.29		
Pinnularia											1.34	2,929	0.10						0.70	2,929	0.10						6.00	806								
Fragilaria	42.08	125,933	84.12	8,125,884					11.02	385.11	70.82	155,242	1.57						69.95	290,956	5.43				19.6	370	2.00	806	19.47							
Surirella			0.02	2,148			0.22		0.42	14.89	0.45	976	0.30		0.17	0.70	12.94	622.22			0.15						6.00	1,342								
Navicula			0.51	49,404			0.22				3.12	6,835			0.17	1.39	0.46	22.22	6.35	26,362	0.31		1.38	3.57	2.0	89	8.00	1,074	1.09		0.96	0.57	1.04	0.29	3.45	1.60
Diatomella																															1.93	1.14			0.86	0.40
Meridion											0.12	488							0.82	1,953							4.00	1,880			1.44	0.86				
Cocconeis			0.11	10,740							3.79	8,299							3.17	13,181																
Frustula																			0.35	1,465																
Cymbella																			0.12	488																
Synedra											0.22	488															2.00	268								
Cyanophyta	0.50	1,489	0.02	2,148	1.02		14.38		54.23	1,896.22	0.22	488	34.98		10.77	45.22	60.24	2,896.22	0.23	976	14.20		25.41	65.71	54.1	1,022	4.00	537	72.43		94.23	56.00	92.72	25.43	93.10	43.20
Microcystis	0.50	1,489	0.02	2,148	1.02		14.38		54.23	1,896.22	0.22	488	34.98		10.77	45.22	60.24	2,896.22	0.23	976	13.15		25.41	65.71	53.7	1,015	4.00	537	72.21		94.23	56.00	92.72	25.43	93.10	43.20
Oscillatoria																					1.05				0.4	7			0.22							
Protozoa (Sarcodina)																					0.62				0.8	15			0.44							
Centropyxis																					0.62				0.8	15			0.44							
Gastrotricha													0.20				0.31	14.89			0.10								0.22							
Rotatoria	9.00	4,444	0.11	10,740	13.26		25.49		0.64	22.22			0.59		2.07	8.70	0.62	29.56			1.57		1.38	3.57												
Kellicottia	0.80	1,489			4.08		0.87						0.49		1.90	8.00					0.21		1.38	3.57												
Keratella	0.50	1,489	0.11	10,740	2.04				0.22	7.33			0.10		0.10	0.70					0.94															
Conochilus					6.12		24.18																													
Asplanchna					1.02		0.22																													
unidentified	0.80	1,489					0.22		0.42	14.89							0.62	29.56			0.62															
Arthropoda	6.93	20,733			3.06		1.70		1.70	59.33			0.59		2.02	4.52	2.47	118.44			5.01		0.83	2.14	1.2	22			0.88		0.96	0.57	3.12	0.86		
Crustacea																																				
Copepoda (adult)	2.47	7,400			1.02																															
copepodid	0.50	2,956					0.22										1.89	29.56																		
nauplius	0.50	8,889					1.31						0.10				0.15	7.33			0.15								0.22							
Cladocera	0.50	1,489			2.04		1.31		0.42	14.89			0.98		0.84	3.48	1.09	51.78			2.19		0.83	2.14	0.4	7			0.22							
Hydracarina																															0.48	0.29	1.04	0.29		
Insecta																																				
Plecoptera nymph							0.22		1.06	37.11			0.79		0.04	1.39					1.09				0.4	15			0.44		0.48	0.29	1.04	0.29		
Ephemeroptera nymph									0.22	7.33			0.10		0.08	0.35	0.15	7.33			0.15															
Diptera larva																																				
Tendipedidae															0.04	0.35	0.46	22.22			0.10												1.04	0.29		
TOTAL	100	299,266	100	9,659,556	100		100		100	3,496.43	100	219,193	100		100	419.83	100	4,807.11	100	415,930	100		100	258.55	100	1,888	100	13,425	100		100	59.43	100	27.43	100	46.40

APPENDIX K

Abundance of Non-diatom Algal Genera and Estimated Rank Relative to One Another and to Diatoms as a Group

Abundance of nondiatom algal genera and estimated rank relative to one another and to diatoms as a group

	STATION	NAD		SC1		SC2		SC3
TAXA	DATES	07/19/77	10/20/77	07/19/77	02/09/78	07/19/77	03/21/77	07/20/77
Chlorophyta (Green Algae)								
Ankistrodesmus								R
Cladophora								
Closterium								
Cosmarium							R	R
Hormidium								
Mougeotia								
Oedogonium		C						
Pediastrum								
Rhizoclonium								
Spirogyra								
Spondylosium								
Staurastrum								
Stigeoclonium								
Ulothrix								A
Zygnema								
Chrysophyta (Golden-brown Algae)								
Bacillariophyceae		VA	VA	VC	C	C	A	VA
Botryococcus								
Chrysapsis								
Hydrurus								C
Tribonema		A	A					
Uroglena								
Vaucheria				R				
Rhodophyta (Red Algae)								
Audouinella								
Cyanophyta (Blue-green Algae)								
Anabaena								
Chroococcus								
Coelosphaerium								
Comphosphaeria							R	
Hyella								
Merismopedia								R
Microcystis								
Oscillatoria				C			C	
Phormidium			R			R	VA	VA
Romeria		VA						
No. Nondiatom Genera		3	2	2	0	1	4	6

(Total Genera - All Dates and Stations = 32)

VA = Very Abundant, A = Abundant, VC = Very Common, C = Common and R = Rare.

STATION	SC3	SC4	LC1			
TAXA DATES	10/20/77	04/20/77	04/20/77	07/20/77	10/20/77	02/10/78
Chlorophyta (Green Algae)						
Ankistrodesmus						
Cladophora						
Closterium						
Cosmarium	R				R	
Hormidium	R	VA				C
Mougeotia					VC	R
Oedogonium						
Pediastrum						
Rhizoclonium						
Spirogyra	VC	C		A	C	
Spondylosium						
Staurastrum						
Stigeoclonium	C		C			
Ulothrix	A	R	C	VC		C
Zygnema	A		A	A	A	
Chrysophyta (Golden-brown Algae)						
Bacillariophyceae	VA	A	A	VC	A	VA
Botryococcus						R
Chrysapsis	C					
Hydrurus	C					
Tribonema	R				R	
Uroglena						
Vaucheria						
Rhodophyta (Red Algae)						
Audouinella						
Cyanophyta (Blue-green Algae)						
Anabaena						
Chroococcus					R	
Coelosphaerium						
Comphosphaeria						
Hyella						
Merismopedia					R	R
Microcystis						C
Oscillatoria						
Phormidium	A	C	C	C	VA	
Romeria						
No. Nondiatom Genera	10	4	4	4	8	6

(Total Genera - All Dates and Stations = 32

VA = Very Abundant, A = Abundant, VC = Very Common, C = Common and R = Rare.

(continued) Page 3

STATION	LC2				KC1	LC3	LC4
TAXA DATES	04/19/77	07/20/77	10/20/77	02/10/78	04/20/77	03/21/77	04/21/77
Chlorophyta (Green Algae)							
Ankistrodesmus							
Cladophora							
Closterium	R	R	VC	R		R	
Cosmarium	R	VC	VC			R	
Hormidium			R				
Mougeotia		VC	R				
Oedogonium							
Pediastrum			R				
Rhizoclonium			A				
Spirogyra		VA	A				
Spondylosium		R					
Staurastrum			C				
Stigeoclonium			R				
Ulothrix		A	R	R	A	C	A
Zygnema	A	C	A				
Chrysophyta (Golden-brown Algae)							
Bacillariophyceae	A	A	VA	A	A	A	A
Botryococcus							
Chrysapsis							
Hydrurus						VA	
Tribonema			R				
Uroglena			R				
Vaucheria							
Rhodophyta (Red Algae)							
Audouinella							
Cyanophyta (Blue-green Algae)							
Anabaena			R				
Chroococcus							
Coelosphaerium							
Comphosphaeria							
Hyella			R				
Merismopedia	R	R	C			R	R
Microcystis							
Oscillatoria		C	VC	R		R	R
Phormidium	A	A	VA			VA	C
Romeria							
No. Nondiatom Genera	5	10	18	3	1	7	5

(Total Genera - All Dates and Stations = 32)

VA = Very Abundant, A = Abundant, VC = Very Common, C = Common and R = Rare.

TAXA	STATION DATES	KR1 04/21/77	RC1 07/21/77
Chlorophyta (Green Algae)			
Ankistrodesmus			
Cladophora		R	
Closterium			R
Cosmarium			
Hormidium			
Mougeotia			
Oedogonium			
Pediastrum			
Rhizoclonium			
Spirogyra			
Spondylosium			
Staurastrum			
Stigeoclonium			
Ulothrix		R	R
Zygnema			
Chrysophyta (Golden-brown Algae)			
Bacillariophyceae		VA	C
Botryococcus			
Chrysapsis			
Hydrurus			
Tribonema			
Uroglena			
Vaucheria			
Rhodophyta (Red Algae)			
Audouinella			R
Cyanophyta (Blue-green Algae)			
Anabaena		C	
Chroococcus			
Coelosphaerium			R
Comphosphaeria			
Hyella			
Merismopedia			
Microcystis			
Oscillatoria			
Phormidium		A	A
Romeria			
No. Nondiatom Genera		4	5

(Total Genera - All Dates and Stations = 32)

VA = Very Abundant, A = Abundant, VC = Very Common, C = Common and R = Rare.

APPENDIX L

Percent Relative Abundance (PRA) of Diatom Taxa

Percent relative abundance (PRA) of diatom taxa from Lake Creek.

TAXA	10/20/77		2/10/78	
	LC1	LC2	LC1	LC2
Achnanthes calcar Cl.			t	
A. clevei Grun.	0.2		t	t
A. clevei var. *rostrata* Hust.			0.4	
A. deflexa Reim.	4.7	6.5	5.8	3.1
A. didyma Cl.		t		
A. exigua Grun.	0.2	0.2		t
A. flexella (Kutz.) Grun.	t	0.2	t	0.4
A. grimmei Krasske		0.4		
A. hauckiana Grun.			t	
A. lanceolata (Breb.) Grun.	0.2	0.2	0.4	0.2
A. lanceolata var. *dubia* Grun.	0.4	0.4		t
A. lanceolata var. *omissa* Reim.		0.2		
A. lapponica var. *ninckei* (Guerm & Mang) Reim.	0.2	0.5	0.2	0.5
A. levanderi Hust.			1.2	0.7
A. linearis (W. Sm.) Grun.	0.4	2.7	0.2	t
A. linearis f. *curta* H. L. Sm.		X	0.9	0.9
A. marginulata Grun.	2.3	0.2	0.2	0.7
A. maxima A. Cl.		t		
A. maxima var. *lanceolata* Østr.		t		
A. microcephala (Kutz.) Grun.	2.4	2.2	2.3	t
A. minutissima Kutz.	21.1	29.7	16.0	23.0
A. oestrupi (A. Cl.) Hust.	t		t	
A. peragalli Brun. & Herib.	0.2	t	0.2	
A. peragalli var. *fossilis* Temp. & Perag.			0.2	
A. rupestris Krasske			0.2	
Amphipleura pellucida Kutz.	t	0.2		t
Amphora ovalis (Kutz.) Kutz.		t	t	
A. ovalis var. *pediculus* (Kutz.) V. H.		t	0.4	
A. perpusilla (Grun.) Grun.	0.2	0.2	0.2	0.4
Anomoeoneis serians (Breb. ex Kutz.) Cl.	0.2	t		
A. vitrea (Grun.) Ross comb. nov.	0.2	0.2	t	0.2
Asterionella formosa Hass.	0.2	0.2	22.8	17.4
Caloneis bacillum (Grun.) Cl.			0.4	
C. limosa (Kutz.) Patr. comb. nov.		t	t	

Continued.

TAXA	10/20/77		2/10/78	
	LC1	LC2	LC1	LC2
Cocconeis placentula Ehr.	0.9	0.5	0.7	t
Cyclotella glomerata Bachmann	0.6	0.2		
C. kutzingiana Thwaites			0.2	
C. sp. #1	0.4	0.4	t	0.4
C. sp. #2	0.6	0.4	0.2	0.2
Cymbella affinis Kutz.	4.9	2.2	t	0.5
C. angustata (W. Sm.) Cl.		t		
C. amphicephala Naeg.		t		
C. cesatii Grun.	0.9	1.6	0.2	0.4
C. cistula (Ehr.) Kirchn.	0.8	0.9	t	1.4
C. cymbiformis Ag.			t	0.2
C. delicatula Kutz.	0.4	0.7	t	t
C. diluviana (Krasske) Florin		t		
C. hustedii Krasske			t	
C. hybrida Grun.		t		
C. lanceolata (Ag.) Ag.		t		
C. mexicana (Ehr.) Cl.	t	0.2	t	
C. microcephala Grun.	1.1	4.0	0.5	1.1
C. minuta Hilse ex Rabh.	2.4	1.4	1.4	4.1
C. minuta f. latens (Krasske) Reim.	X	X		
C. muelleri Hust.		t	t	
C. naviculiformis (Auersw. ex Rabenh.) Kirchn.			t	
C. rupicola Grun.			t	
C. simuata Greg.	0.2	0.4	0.2	0.4
C. subaequalis Grun.				t
Denticula elegans Kutz.			0.2	t
D. tenuis Kutz.	t	1.4		
Diatoma hiemale (Roth.) Heib.		t	t	t
D. hiemale var. *mesodon* (Ehr.) Grun.		0.2		t
D. tenue Ag.				3.1
D. tenue var. *elongatum* Lyngb.	1.3	0.2	9.1	
Didymosphenia geminata (Lyngb.) M. Schmidt	t	t	0.2	
Diploneis elliptica (Kutz.) Cl.		0.2		
D. oblongella (Naeg. ex Kutz.) Ross				t
Epithemia adnata var. *porcellus* (Kutz.) Patr. comb. nov.	t			

Table . Continued.

TAXA	10/20/77 LC1	 LC2	2/10/78 LC1	 LC2
Epithemia sorex Kutz.		0.2	t	
E. turgida (Ehr.) Kutz.			t	
Eunotia incisa W. Sm. ex Greg.	0.2			
E. sp. #1	t	t		t
Fragilaria brevistriata Grun.	2.8	0.2	2.1	t
F. capucina var. *mesolepta* Rabh.			4.4	5.4
F. construens (Ehr.) Grun.	2.6	1.3	3.1	5.6
F. construens var. *binodis* (Ehr.) Grun.	t	t		
F. construens var. *pumila* Grun.	t			
F. construens var. *venter* (Ehr.) Grun.	7.5	5.1	4.4	3.6
F. crotonensis Kitton.	4.7	3.4	5.2	4.7
F. leptostauron (Ehr.) Hust.	0.2	1.4	0.4	0.9
F. leptostauron var. *dubia* (Grun.) Hust.		0.9		0.4
F. pinnata Ehr.	2.4	1.1	0.9	0.5
F. vaucheriae (Kutz.) Peters	4.0	7.8	3.0	3.4
Frustulia rhomboides (Ehr.) de Toni	t			
F. rhomboides var. *amphipleuroides* (Grun.) Cl.			t	
Gomphonema acuminatum Ehr.	0.2	t		
G. affine Kutz.	t			
G. angustatum (Kutz.) Rabh.		0.2	t	0.4
G. clevei Fricke	t	0.2	t	
G. dichotomum Kutz.	1.9	0.9	0.4	t
G. intricatum Kutz.			t	
G. olivaceoides Hust.		t	1.9	0.2
G. quadripunctatum (Ostr.) Wisl.		0.4	0.5	
G. subtile Ehr.	0.6			
G. tergestinum (Grun.) Fricke	0.4			
G. truncatum Ehr.	t			
Hannaea arcus (Ehr.) Patr.	7.0	0.4	0.4	0.9
Melosira ambigua (Grun.) O. Mull.		1.3		
M. distans (Ehr.) Kutz.	t	t		
M. granulata (Ehr.) Ralfs.	0.2			
M. granulata var. *angustissima* Mull.	1.3			
M. italica (Ehr.) Kutz.	1.9	2.4	0.9	0.5
Meridion circulare (Grev.) Ag.		t		

Table . Continued.

TAXA	10/20/77		2/10/78	
	LC1	LC2	LC1	LC2
Navicula acceptata Hust.			0.2	t
N. aerophila Krasske			t	
N. anglica Ralfs.		0.2		
N. arvensis Hust.		0.2	t	0.2
N. aurora Sov.	t	t		
N. bicephala Hust.		t		
N. capitata Ehr.		t		
N. cari Ehr.		t		
N. cocconeiformis Greg. ex Grev.			t	
N. contenta Grun.	0.2			
N. cryptocephala Kutz.	t			t
N. cryptocephala var. *veneta* (Kutz.) Rabh.	0.4			
N. detenta Hust.			t	
N. gastrum (Ehr.) Kutz.		t		
N. gottlandica Grun.		0.2		
N. graciloides A. Mayer	t		0.2	
N. jaernefeltii Hust.	0.2		t	0.2
N. laevissima Kutz.				0.2
N. menisculus Schum.	0.2			
N. menisculus var. *upsaliensis* (Grun. in Cl. & Grun.) Grun.		t		
N. mournei Patr.			0.2	
N. muralis Grun.			0.2	
N. notha Wallace	0.2		0.2	t
N. protracta Grun.			0.2	0.2
N. pseudoscutiformis Hust.	0.6	t	0.2	0.2
N. pseudosilicula f. *olympica* Sov.		t		
N. pupula Kutz.	t	0.2	0.2	
N. pupula var. *mutata* (Krasske) Hust.	0.2			
N. radiosa Kutz.	t	t		t
N. radiosa var. *parva* Wallace	0.4	0.4		t
N. rhynchocephala Kutz.			t	
N. rotaeana (Rabh.) Grun.	0.2		0.4	0.2
N. rotunda Hust.			0.2	
N. schmassmanii Hust.				t
N. secura Patr.		t		

Table . Continued.

TAXA	10/20/77		2/10/78	
	LC1	LC2	LC1	LC2
Navicula semen Ehr. emend Donk.		t		
N. semenoides Hust.			t	
N. seminulum Grun.	0.2			
N. seminulum var. *radiosa* Hust.			0.2	
N. subhamulata Grun.			0.2	
N. verecunda Hust.		t		
N. sp. #6		0.2		
N. sp. #7			0.7	
N. sp. #8			t	t
Neidium affine var. *longiceps* (Greg.) Cl.		t		
N. bisulcatum (Lagerst.) A. Cl.			t	
N. iridis var. *amphigomphus* (Ehr.) A. Mayer		t		
Nitzschia dissipata (Kutz.) Grun.	t	0.2	0.4	t
N. fonticola Grun.	t	0.4		t
N. hantzschiana Rabh.				0.7
N. linearis (Ag. ex W. Sm.) W. Sm.		t		
N. microcephala Grun.	t	0.7		
N. palea (Kutz.) W. Sm.	0.2	t		
N. sp. #1	0.9	0.9	0.4	1.1
N. sp. #5			0.2	
N. sp. #6	0.2	2.5		
N. sp. #7				1.1
Pinnularia maior (Kutz.) Rabh.			t	
P. viridis var. *minor* Cl.		t	t	
Rhopalodia gibba (Ehr.) O. Mull.				t
Stauroneis anceps Ehr.	t	t		
S. phoenicenteron f. *gracilis* (Ehr.) Hust.		t	t	
Stephanodiscus astraea (Ehr.) Grun.	0.2	0.2	t	t
S. dubius (Fricke) Hust.				t
Surirella linearis W. Sm.		t		
S. linearis var. *helvetica* (Brun.) Meister			t	
Synedra filiformis var. *exilis* Cl.-Eul.		t		
S. minuscula Grun.	2.1		1.0	2.7
S. parasitica (W. Sm.) Hust.				t

Table . Continued.

TAXA	10/20/77		2/10/77	
	LC1	LC2	LC1	LC2
Synedra parasitica var. *subconstricta* (Grun.) Hust.			t	
S. rumpens Kutz.	0.6	7.4		
S. rumpens var. *fragilarioides* Grun.	0.4			0.2
S. rumpens var. *scotica* Grun.			0.2	1.3
S. rumpens var. ?		t		
S. ulna (Nitz.) Ehr.	5.3	1.3	0.7	3.6
S. ulna var. *contracta* Østr.	0.6	1.1	0.7	0.5
Tabellaria fenestrata (Lyngb.) Kutz.	0.9	0.2	1.9	2.2
T. flocculosa (Roth) Kutz.	0.8			

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

X = indicates that taxon was observed in the sample but not distinguished from the normal form or nominate variety in the proportional count.

Percent relative abundance (PRA) of diatom taxa from the ASARCO North Exploratory Adit Discharge.

TAXA	7/19/77	10/20/77
	NAD	NAD
Achnanthes minutissima Kutz.	14.8	60.2
Cymbella minuta Hilse ex. Rabh.	3.6	4.2
C. minuta f. latens (Krasske) Reim.	-	t
Diatoma hiemale var. *mesodon* (Ehr.) Grun.	81.6	35.6
Gomphonema angustatum (Kutz.) Rabh.	t	-
Navicula lamii Manguin	-	t

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

Percent relative abundance (PRA) of diatom taxa from Lake Creek

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
Achnanthes affinis Grun.			0.2		0.4	0.2
A. calcar Cl.		0.2			t	
A. clevei Grun.					t	
A. deflexa Reim.	1.0	6.0	61.0	2.9	3.1	6.0
A. exigua var. heterovalva Krasske					0.4	
A. flexella (Kutz.) Grun.		0.2			0.2	
A. hustedtii (Krasske) Reim.					0.2	
A. lanceolata (Breb.) Grun.	0.2	0.4	t	0.4	0.4	0.2
A. laceolata var. dubia Grun.				0.2	t	
A. lapponica var. ninckei (Guerm & Mang) Reim.	5.5	0.4		2.3	0.2	0.5
A. linearis (W. Sm.) Grun.	2.5	0.9				0.5
A. linearis f. curta H. L. Sm.	X	X			0.8	0.5
A. linearis var. pusilla Grun.					0.6	
A. marginulata Grun.	0.2	0.6		t	1.2	0.9
A. microcephala (Kutz.) Grun.	2.4	36.0	19.7		1.6	2.2
A. minutissima Kutz.	46.9	3.2	0.2	40.6	19.4	41.1
A. peragalli Brun. & Herib.					0.2	
A. peragalli var. fossilis Temp. & Perag.					t	
A. peragalli var. parvula (Patr.) Reim. comb. nov.						0.2

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
A. sp. #3		t				
A. sp. #6	0.2					
Amphipleura pellucida Kutz.	0.3	0.2		t	t	t
Amphora ovalis (Kutz.) Kutz.		t				
A. ovalis var. affinis (Kutz.) V. H. ex DeT.	t				t	t
A. perpusilla (Grun.) Grun.	0.2	t		0.2	0.2	0.5
Anomoeoneis vitrea (Grun.) Ross comb. nov.				0.2	0.2	0.4
Asterionella formosa Hass.		0.4	0.2			
Caloneis alpestris (Grun.) Cl.					t	
C. lewisii var. inflata (Schultze) Patr.			t			
C. limosa (Kutz.) Patr. comb. nov.					t	
C. ventricosa var. alpina (Cl.) Patr. comb. nov.		t				
C. ventricosa var. truncatula (Grun.) Meist.				0.2		
C. sp.			t			
Cocconeis diminuta Pant.					t	0.2
C. klamathensis Sov.						t
C. placentula Ehr.	0.3	1.3	0.2	1.7	1.0	2.1
Cocconeis placentula var. lineata (Ehr.) V.H.						0.2
Cyclotella bodanica Eulenstein	0.3		t	0.4	t	
C. kutzingiana Thwaites	0.7					
C. kutzingiana var. planetophora Fricke					0.2	0.2

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
C. ocellata Pantocsek		t		0.2		
C. sp. #1		1.1	0.2	0.2	t	0.5
C. sp. #2		1.9	0.5	1.1	2.7	2.1
Cymatopleura solea (Breb. & Godey) W. Sm.						t
Cymbella affinis Kutz.	1.0	0.6	5.8	0.4	1.4	0.5
C. amphicephala Naeg.					0.2	
C. cesatii Grun.	t	0.2	t	0.2	0.6	t
C. cistula (Ehr.) Kirchn.		t	0.4	0.6	t	t
C. cymbiformis Ag.			0.4	0.2	0.2	
C. delicatula Kutz.			0.2	t	2.1	0.2
C. diluviana (Krasske) Florin				0.2	0.2	t
C. heteropleura var. *subrostrata* Cl.						t
C. inaequalis (Ehr.) Rabh.					t	
C. lanceolata (Ag.) Ag.						t
C. mexicana (Ehr.) Cleve		t	t	0.2	t	t
C. microcephala Grun.	1.7	0.4	t	2.1	2.7	2.4
C. minuta Hilse ex Rabh.	13.6	5.2	0.2	12.0	1.6	3.4
C. minuta f. *latens* (Krasske) Reim.	X				X	
C. muelleri Hust.		t			t	

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
C. naviculiformis (Auersw. ex Rabenh.) Kirchn.		t	0.2	0.2	t	t
C. rupicola Grun.			t		t	t
C. sinuata Greg.	1.3	0.6		1.3	0.2	1.0
C. sp.				0.2		
Denticula elegans Kutz.					t	t
D. sp.		t				
Diatoma hiemale (Roth.) Heib.	0.3	0.4		1.1		t
D. hiemale var. mesodon (Ehr.) Grun.	2.2	0.2	t	1.0	0.4	
D. tenue Ag.					0.2	
D. tenue var. elongatum Lyngb.					1.9	
Didymosphenia geminata (Lyngb.) M. Schmidt	t	0.4	t	0.2	0.4	t
Diploneis elliptica (Kutz.) Cl.		t	t		t	t
Epithemia adnata var. minor (Perag. & Herib.) Patr. comb. nov.		t				
E. turgida (Ehr.) Kutz.		t	t		0.2	t
Eunotia incisa W. Smith ex Greg.		0.2			0.2	
E. naegelii Migula		t				
E. praerupta var. gidens (Ehr.) Grun.		t				
E. tenella (Grun.) Cl.		t			0.4	0.2
Fragilaria bicapitata A. Mayer					t	

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
F. brevistriata Grun.	t	0.4		0.2	1.2	2.2
F. brevistriata var. *inflata* (Pant.) Hust.		t	t		0.8	
F. capucina Desm.					t	
F. capucina var. *mesolepta* Rabh.						t
F. construens (Ehr.) Grun.	0.2	1.3	0.5	3.0	1.8	0.7
F. construens var. *binodis* (Ehr.) Grun.					0.4	t
F. construens var. *pumila* Grun.					0.2	
F. construens var. *venter* (Ehr.) Grun.	1.8	7.1	0.5	4.0	8.7	5.9
F. crotonensis Kitton.		1.5	t	0.6	6.6	2.4
F. leptostauron var. *dubia* (Grun.) Hust.		t	t		0.6	0.4
F. leptostauron (Ehr.) Hurst.		t			0.8	1.2
F. pinnata Ehr.	0.2	0.9	0.4		1.0	t
F. pinnata var. *intercedens* (Grun.) Hust.						0.2
F. vaucheriae (Kutz.) Peters	5.9	7.1	0.9	4.0	6.6	6.2
F. vaucheriae var. *capitellata* (Grun.) Peters					1.0	
F. virescens Ralfs.		0.2			t	
F. virescens var. *mesolepta* Rabh.					t	
Frustulia rhomboides (Ehr.) de Toni		t			0.2	t
F. rhomboides var. *amphipleuroides* (Grun.) Cl.				0.2	t	0.2
F. vulgaris (Thwaites) DeT.			t			
Gomphoneis herculeana (Ehr.) Cl.			t		t	

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
Gomphonema acuminatum Ehr.		t	t		t	t
G. angustatum (Kutz.) Rabh.	0.5			1.0	0.4	0.4
G. dichotomum (Kutz.)			0.2		0.2	0.4
G. gracile Ehr. emend. V. H.					0.2	
G. intricatum Kutz.		0.2	0.2			
G. manubrium Fricke					t	0.2
Gomphonema olivaceoides Hust.	0.2	2.2	5.0		t	0.2
G. quadripunctatum (Østr.) Wisl.						0.4
G. subclavatum var. *mexicanum* (Grun.) Patr.					t	0.2
G. truncatum Ehr.					0.2	t
Hannaea arcus (Ehr.) Patr.	4.0	0.6	t	t	0.2	0.2
Hantzschia amphioxys (Ehr.) Grun.		t			t	t
H. elongata (Hant.) Grun.		t				
Melosira distans (Ehr.) Kutz.				0.2	0.8	t
M. granulata var. *angustissima* Mull.	t		0.4			0.5
M. italica (Ehr.) Kutz.		6.0	t	2.7	0.6	1.0
Meridion circulare (Grev.) Ag.	0.3				0.4	t
M. circulare var. *constrictum* (Ralfs.) V.H.		t				
Navicula arvensis Hust.		t		0.8		
N. aurora Sov.		t			t	t

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
N. bacillum Ehr.		0.2				t
N. cascadensis Sov.		t			t	
N. cocconeiformis Greg. ex Grev.		t				0.2
N. cryptocephala Kutz.	t	t		0.4		0.2
N. cryptocephala var. *veneta* (Kutz.) Rabh.	0.2	t	t	0.8	0.2	0.2
N. dicephala (Ehr.) W. Sm.					t	
N. exigua Greg. ex Grun.						t
N. gottlandica Grun.		t			0.2	
N. graciloides A. Mayer		t				
N. heufleri Grun.		t				
N. hustedtii Krasske					0.2	
N. lanceolata (Ag.) Kutz.					t	
N. minima Grun.		0.2				
N. mournei Patr.					t	
N. notha Wallace						0.2
N. oblonga (Kutz.) Kutz.		t				
N. pseudoscutiformis Hust.		0.4	t	t	0.4	t
N. pupula Kutz.		t			t	t
N. pupula var. *elliptica* Hust.		t				
N. pupula var. *mutata* (Krasske) Hust.					0.2	t

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
N. pupula var. *rectangularis* (Greg.) Grun.		t				
N. radiosa Kutz.				t	0.2	
Navicula radiosa var. *parva* Wallace		0.4				0.2
N. radiosa var. *tenella* (Breb. & Kutz.) Grun.					t	
N. rhynchocephala Kutz.					t	
N. rotaeana (Rabh.) Grun.					0.6	
N. secreta var. *apiculata* Patr.				0.4		
N. semen Ehr. emend Donk.		t				
N. seminulum Grun.		t				
N. vanheurckii Patr. sp. nov.		t				
N. sp. #1					0.2	
N. sp. #3			t			
N. sp. #4		t	0.2		0.2	
Neidium affine (Ehr.) Pfitz.					t	
N. affine var. *ceylonicum* (Skv.) Reim.					t	
N. dubium (Ehr.) Cl.					t	
Nitzschia acicularis (Kutz.) W. Sm.		0.2		0.2	0.2	0.4
N. angustata (W. Sm.) Grun.		0.2		0.2		

continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
N. angustata var. acuta Grun.					t	
N. communis Rabh.				0.4		
N. denticula Grun.					0.2	
N. dissipata (Kutz.) Grun.	1.3	0.6		1.5	0.2	
N. fonticola Grun.	0.2	0.2			0.4	0.5
N. frustulum Kutz.		0.9		0.4		
N. kutzingiana Hilse				1.1	0.2	
N. linearis (Ag. ex W. Sm.) W. Sm.	t	t		0.2		0.2
N. microcephala Grun.	t			0.2		t
N. palea (Kutz.) W. Sm.	1.8	0.2		1.1	t	0.2
N. paleacea Grun.				0.2		
N. recta Hantz.	0.5					
N. romana Grun.						t
N. sp. #1	0.3	1.1	t	2.3	2.1	0.9
N. sp. #2		t				
N. sp. #3					0.2	0.2
N. sp. #4						0.2
Pinnularia borealis Ehr.		t				
P. maior (Kutz.) Rabh.					t	t
P. sp. #1		t			0.2	

Table continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
Pinnularia sp. #3				t		
P. sp. #4				0.2		
Rhopalodia gibba (Ehr.) O. Mull.		t				
R. parallela (Grun.) O. Mull.					t	0.2
Stauroneis anceps Ehr.					t	
S. anceps f. linearis (Ehr.) Hust.					t	
S. fluminea Patr. & Freese		0.2				
S. phoenicenteron (Nitz.) Ehr.		t				
S. phoenicenteron f. gracilis (Ehr.) Hust.	t				t	t
Stephanodiscus astraea (Ehr.) Grun.		0.2	t	0.4	0.4	0.2
S. dubius (Fricke) Hust.						t
S. minutus Cl. & Moll.				0.4		
Surirella angustata Kutz.					t	
S. linearis var. constricta (Ehr.) Grun.					t	
S. linearis var. helvetica (Brun.) Meister		t				t
S. ovata Kutz.				0.2		
S. ovata var. pinnata (W. Sm.)	t					
Synedra acus Kutz.					1.2	0.2
S. cyclopum Brutschy					t	

Table continued.

TAXA	3/21/77	4/19/77	4/20/77	4/21/77	7/20/77	
	LC3	LC2	LC1	LC4	LC1	LC2
S. delicatissima W. Sm.		0.2				
S. demerarae Grun.						0.2
S. filiformis var. *exilis* Cl.-Eul.		0.9	1.6	0.6	0.6	t
S. minuscula Grun.	0.7	1.9	0.2	0.6	6.0	2.4
S. rumpens Kutz.	0.5		t			
S. rumpens var. *fragilarioides* Grun.				t	1.2	0.5
S. rumpens var. *scotica* Grun.					0.8	0.4
S. ulna (Nitz.) Ehr.	0.3	0.2	0.4	1.3	2.7	2.6
Tabellaria fenestrata (Lyngb.) Kutz.		3.6	0.2	0.6	3.1	0.4
T. flocculosa (Roth.) Kutz.			0.2			
T. sp.	t					
Thalassiosira fluviatilis Hust.					t	

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

X = indicates that taxon was observed in the sample but not distinguished from the normal form or nominate variety in the proportional count.

Percent relative abundance (PRA) of diatom taxa from Kootenai River

TAXA	4/21/77 KR1
Achnanthes deflexa Reim.	t
A. lanceolata (Breb.) Grun.	t
A. lanceolata var. *dubia* Grun.	t
A. minutissima Kutz.	20.8
Amphora perpusilla (Grun.) Grun.	1.7
Asterionella formosa Hass.	1.5
Cocconeis pediculus Ehr.	0.2
C. placentula Ehr.	1.1
Cyclotella bodanica Eulenstein	t
Cymatopleura solea (Breb. & Godey) W. Sm.	t
Cymbella affinis Kutz.	0.2
C. cistula (Ehr.) Kirchn.	t
C. minuta Hilse ex Rabh.	6.8
C. sinuata Greg.	0.4
Diatoma hiemale var. *mesodon* (Ehr.) Grun.	0.2
D. tenue Ag.	1.7
D. vulgare Bory	22.3
Eunotia sp.	0.2
Fragilaria crotonensis Kitton.	t
F. vaucheriae (Kutz.) Peters	3.9
Gomphonema clevei Fricke	t
G. intricatum Kutz.	0.2
G. olivaceoides Hust.	t
G. olivaceum (Lyngb.) Kutz.	1.7
Hannaea arcus (Ehr.) Patr.	0.6
Melosira granulata var. *angustissima* Mull.	t

Table continued.

TAXA	4/21/77 KR1
M. italica (Ehr.) Kutz.	0.2
M. varians Ag.	0.9
Navicula cryptocephala Kutz.	t
N. cryptocephala var. *veneta* (Kutz.) Rabh.	3.7
N. exigua var. *capitata* Patr.	0.2
N. tripunctata (O. F. Mull.) Bory	2.6
Neidium iridis (Ehr.) Cl.	0.2
Nitzschia acuta Hantz.	t
N. dissipata (Kutz.) Grun.	0.9
Nitzschia epiphytica O. Mull.	0.2
N. kutzingiana Hilse	0.7
N. paleacea Grun.	0.2
N. sigmoidea (Ehr.) W. Sm.	t
N. sp. #1	0.2
Rhoicosphenia curvata (Kutz.) Grun.	0.2
Stephanodiscus astraea (Ehr.) Grun.	t
S. minutus Cl. & Moll.	26.6
Synedra minuscula Grun.	t
S. ulna (Nitz.) Ehr.	t

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

Percent relative abundance (PRA) of diatom taxa from Keeler Creek

TAXA	4/20/77 KC1
Achnanthes lanceolata (Breb.) Grun.	0.2
A. microcephala (kutz.) Grun.	80.2
Cocconeis placentula Ehr.	0.2
Cymbella minuta Hilse ex Rabh.	1.5
Diatoma hiemale var. mesodon (Ehr.) Grun.	t
Frustulia rhomboides (Ehr.) de Toni	t
Gomphonema angustatum (Kutz.) Rabh.	t
G. olivaceoides Hust.	10.2
G. quadripuntatum (Østr.) Wisl.	2.9
Hannaea arcus (Ehr.) Patr.	4.4
Navicula cryptocephala var. veneta (Kutz.) Rabh.	t
N. rotaeana (Rabh.) Grun.	t
Nitzschia sp. #1	0.2
Synedra minuscula Grun.	0.2

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

Percent relative abundance (PRA) of diatom taxa from Ross Creek

TAXA	7/21/77 RC1
Achnanthes deflexa Reim.	8.8
A. lanceolata (Breb.) Grun.	0.9
A. lapponica var. *ninckei* (Guerm & Mang) Reim.	0.8
A. linearis (W. Sm.) Grun.	0.2
A. marginulata Grun.	0.2
A. microcephala (Kutz.) Grun.	46.0
A. sp. #6	0.2
Amphora perpusilla (Grun.) Grun.	0.4
Cocconeis placentula Ehr.	4.5
Cyclotella ocellata Pantocsek	t
Cymbella cistula (Ehr.) Kirchn.	0.4
C. delicatula Kutz.	0.2
C. heteropleura (Ehr.) Kutz.	t
C. minuta Hilse ex Rabh.	3.6
C. minuta f. *latens* (Krasske) Reim.	X
C. naviculiformis (Auersw. ex Rabenh.) Kirchn.	0.2
C. sinuata Greg.	2.6
Diatoma anceps (Ehr.) Kirchn.	t
D. hiemale (Roth.) Heib.	0.4
D. hiemale var. *mesodon* (Ehr.) Grun.	2.4
Didymosphenia geminata (Lyngb.) M. Schmidt	t
Diploneis finnica (Ehr.) Cl.	t
D. puella (Schum.) Cl.	0.2
Eunotia perpusilla Grun.	t
E. tenella (Grun.) Cl.	0.2
Fragilaria bicapitata A. Mayer	0.2
F. brevistriata Grun.	0.6

continued.

TAXA	7/21/77 RC1
F. *construens* (Ehr.) Grun.	0.2
F. *construens* var. *binodis* (Ehr.) Grun.	t
F. *construens* var. *venter* (Ehr.) Grun.	2.8
F. *crotonensis* Kitton.	0.2
F. *pinnata* Ehr.	0.2
F *vaucheriae* (Kutz.) Peters	2.2
Frustulia *rhomboides* var. *amphipleuroides* (Grun.) Cl.	t
Gomphonema *angustatum* (Kutz.) Rabh.	8.4
G. *intricatum* Kutz.	0.2
G. *olivaceoides* Hust.	5.4
G. *parvulum* (Kutz.) Kutz.	t
G. *quadripunctatum* (Østr.) Wisl.	0.8
G. *subclavatum* (Grun.) Grun.	t
G. *tergestinum* (Grun.) Fricke	t
G. sp.	1.1
Hannaea *arcus* (Ehr.) Patr.	2.8
Melosira *italica* (Ehr.) Kutz.	0.6
Meridion *circulare* (Grev.) Ag.	0.2
Navicula *cryptocephala* var. *veneta* (Kutz.) Rabh.	0.4
N. *rotaeana* (Rabh.) Grun.	0.2
Nitzschia *dissipata* (Kutz.) Grun.	0.8
N. *recta* Hantz.	0.2
Synedra *minuscula* Grun.	t
S. *ulna* (Nitz.) Ehr.	0.8

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X indicates that taxon was observed in the sample but not distinguished from the normal form in the proportional count.

Percent relative abundance (PRA) of diatom taxa from Stanley Creek.

TAXA	10/20/77 SC3	2/9/78 SC1
Achnanthes affinis Grun.		2.2
A. clevei var. *rostrata* Hust.	t	
A. deflexa Reim.	23.8	
A. lanceolata (Breb.) Grun.	0.6	0.4
A. lapponica var. *ninckei* (Guerm & Mang) Reim.	0.2	
A. linearis (W. Sm.) Grun.	1.1	1.5
A. linearis f. *curta* H. L. Sm.	X	2.4
A. marginulata Grun.		0.9
A. microcephala (Kutz.) Grun.	5.7	t
A. minutissima Kutz.	22.4	56.8
A. peragalli var. *parvula* (Patr.) Reim. comb. nov.	t	
A. rupestris Krasske		2.8
A. subrostrata Hust.		1.3
Amphora ovalis var. *pediculus* (Kutz.) V. H.	0.2	
A. perpusilla (Grun.) Grun.	0.7	1.5
Cocconeis placentula Ehr.	1.1	1.1
Cyclotella sp. #3		t
Cymbella cesatii Grun.		t
C. cistula (Ehr.) Kirchn.	2.8	
C. minuta Hilse ex Rabh.	1.6	1.1
C. minuta f. *latens* (Krasske) Reim.	X	
C. sinuata Greg.		t
Denticula tenuis Kutz.	1.3	
Diatoma anceps (Ehr.) Kirchn.	t	0.4
D. hiemale (Roth.) Heib.	7.0	0.6
D. hiemale var. *mesodon* (Ehr.) Grun.	16.0	4.3
Diploneis elliptica (Kutz.) Cl.		t
Eunotia perpusilla Grun.	0.4	
Fragilaria brevistriata Grun.	t	
F. construens (Ehr.) Grun.	0.9	
F. construens var. *venter* (Ehr.) Grun.	1.5	
F. pinnata Ehr.	0.2	
F. vaucheriae (Kutz.) Peters	0.9	2.2
F. virescens Ralfs.	1.1	

Continued.

TAXA	10/20/77 SC3	2/9/78 SC1
Frustulia rhomboides (Ehr.) De Toni	t	
Gomphonema angustatum (Kutz.) Rabh.	0.4	0.7
G. dichotomum Kutz.	1.6	
G. instabilis Hohn & Hellerm.	t	
G. quadripunctatum (Østr.) Wisl.	t	2.6
G. tergestinum (Grun.) Fricke	0.4	
Hannaea arcus (Ehr.) Patr.	4.0	0.2
Hantzschia amphioxys (Ehr.) Grun.		t
Melosira italica (Ehr.) Kutz.	t	
Meridion circulare (Grev.) Ag.	1.1	0.4
Navicula arvensis Hust.	0.2	
N. contenta f. *biceps* (Arnott) Grun.		0.2
N. cryptocephala var. *veneta* (Kutz.) Rabh.	0.2	0.6
N. minima Grun.		1.1
N. perpusilla (Kutz.) Grun.		5.2
N. radiosa var. *parva* Wallace		0.4
N. rotaeana (Rabh.) Grun.	t	
Nitzschia dissipata (Kutz.) Grun.	t	2.0
N. hantzschiana Rabh.		4.8
N. linearis (Ag. ex W. Sm.) W. Sm.		0.2
N. microcephala Grun.	1.3	
N. sp. #1	t	
Pinnularia borealis var. *brevicostata* Hust.		t
P. mesolepta var. *angusta* Cl.		1.1
Stauroneis anceps f. *linearis* (Ehr.) Hust.	t	
Synedra rumpens Kutz.	0.7	1.1
S. rumpens var. *familaris* (Kutz.) Hust.	0.2	
S. ulna (Nitz.) Ehr.	t	

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

X = indicates that taxon was observed in the sample but not distinguished from the normal form or nominate variety in the proportional count.

Percent relative abundance (PRA) of diatom taxa from Stanley Creek

TAXA	3/21/77	4/20/77	7/19/77		7/20/77
	SC3	SC4	SC1	SC2	SC3
Achnanthes affinis Grun.				0.2	
A. calcar Cl.	t	t			t
A. clevei Grun.	t				
A. clevei var. *rostrata* Hust.	0.2	0.2			
A. deflexa Reim.	6.8	11.2			37.3
A. flexella (Kutz.) Grun.		t			
A. lanceolata (Breb.) Grun.	0.8	0.2	16.1	45.9	1.1
A. lanceolata var. *haynaldii* (Istv.-Schaarsch) Cl.			X		
A. lapponica var. *ninckei* (Guerm & Mang) Reim.	0.4	0.8			
A. linearis (W. Sm.) Grun.	3.7	2.3	0.6		0.2
A. linearis f. *curta* H. L. Sm.	X	X	0.4		1.1
A. marginulata Grun.			0.2		
A. microcephala (Kutz.) Grun.	4.3	1.0			0.4
A. minutissima Kutz.	39.3	60.4	28.0	16.8	28.4
A. sp. #1	0.2	0.4			
A. sp. #2		0.2	0.2		
A. sp. #4			0.2	0.8	
A. sp. #5			1.7	1.1	
Amphora ovalis var. *affinis* (Kutz.) V. H. ex DeT.					t
A. ovalis var. *pediculus* (Kutz.) V. H.	t				
A. perpusilla (Grun.) Grun.	0.4	1.0	2.6	1.1	0.5
Anomoeoneis vitrea (Grun.) Ross comb. nov.		0.2			0.4

continued.

TAXA	3/21/77	4/20/77	7/19/77		7/20/77
	SC3	SC4	SC1	SC2	SC3
Caloneis hyalina Hust.	0.2				
C. sp.			0.4		
Cocconeis placentula Ehr.	2.9	1.2	0.9	6.7	0.7
C. placentula var. *euglypta* (Ehr.) Cl.	0.2				
C. thumensis A. Mayer		0.2			
Cymbella affinis Kutz.		0.6			
C. amphicephala Naeg.					t
C. cesatii Grun.	0.2				
C. cistula (Ehr.) Kirchn.	9.0	1.4			3.8
C. microcephala Grun.	t	0.4			
C. minuta Hilse ex Rabh.	8.2	1.2	1.7	0.6	3.6
C. minuta f. *latens* (Krasske) Reim.	X				X
C. sinuata Greg.	0.4	t	0.6	2.1	t
Diatoma anceps (Ehr.) Kirchn.	t				
D. hiemale (Roth.) Heib.	t	t	2.1	2.9	0.5
D. hiemale var. *mesodon* (Ehr.) Grun.	6.8	2.9	9.5	5.5	6.6
D. tenue var. *elongatum* Lyngb.		0.2			
Diatomella belfouriana Grev.			0.4		
Didymosphenia geminata (Lyngb.) M. Schmidt		t			
Diploneis elliptica (Kutz.) Cl.	t	t			
D. sp.				t	
Eunotia perpusilla Grun.	t				0.2
E. sp.			t	0.2	
Fragilaria brevistriata Grun.	t	0.2			
F. brevistriata var. *inflata* (Pant.) Hust.	0.2	t			

continued.

TAXA	3/21/77	4/20/77	7/19/77		7/20/77
	SC3	SC4	SC1	SC2	SC3
F. construens (Ehr.) Grun.	0.4	0.2			0.4
F. construens var. *venter* (Ehr.) Grun.	t	1.4	t	0.2	1.1
F. crotonensis Kitton.					1.4
F. pinnata Ehr.	0.2				
F. pinnata var. *lancettula* (Schm.) Hust.	t				
F. vaucheriae (Kutz.) Peters	1.0	0.4	t	5.5	2.2
F. vaucheriae var. *capitellata* (Grun.) Cl.	t				
Frustulia rhomboides (Ehr.) de Toni	0.2	0.4		t	0.4
F. rhomboides var. *amphipleuroides* (Grun.) Cl.			0.2	t	
F. vulgaris (Thwaites) DeT.	0.2				
Gomphonema acuminatum Ehr.	t	t			
G. angustatum (Kutz.) Rabh.	0.2	t	1.5	t	0.2
G. angustatum var. *citera* (Hohn & Hellerm.) Patr. comb. nov.			0.2		
G. dichotomum Kutz.		t			
G. olivaceoides Hust.	0.8	0.2	0.2		1.4
G. parvulum (Kutz.) Kutz.				t	t
G. quadripunctatum (Østr.) Wisl.			11.2	1.1	t
G. simus Hohn & Hellerm.			0.4		
Hannaea arcus (Ehr.) Patr.	2.2	1.5	2.1	0.6	4.3
Melosira distans (Ehr.) Kutz.	0.8				t
M. italica (Ehr.) Kutz.	t				
M. varians Ag.					t
Meridion circulare (Grev.) Ag.	1.0	t	t	0.4	0.5
Navicula arvensis Hust.				0.2	
N. aurora Sov.		t			

continued.

TAXA	3/21/77	4/20/77	7/19/77		7/20/77
	SC3	SC4	SC1	SC2	SC3
N. bacillum Ehr.				t	
N. cascadensis Sov.		0.2			
N. cryptocephala Kutz.		t			
N. cryptocephala var. *veneta* (Kutz.) Rabh.	0.4	0.8	0.6	0.8	0.2
N. graciloides A. Mayer	t				
N. minima Grun.					0.4
N. notha Wallace	t				
N. paucivisitata Patr.	t				
N. perpusilla (Kutz.) Grun.			t	0.4	
N. pupula var. *mutata* (Krasske) Hust.	t				
N. radiosa var. *parva* Wallace					0.2
N. tripunctata (O. F. Mull.) Bory		t		0.2	
N. sp. #1	0.2				
N. sp. #2	t				
N. sp. #3	t	0.2	8.4	3.6	
N. sp. #5		0.2			
Neidium binode (Ehr.) Hust.		t			
Nitzschia capitellata Hust.	t	0.2			
N. communis Rabh.	0.4		0.2		
N. dissipata (Kutz.) Grun.	2.3	1.5	9.4	2.3	0.2
N. fonticola Grun.	0.8				0.2
N. frustulum Kutz.				0.2	0.2
N. kutzingiana Hilse	t				
N. linearis (Ag. ex W. Sm.) W. Sm.		t		t	
N. microcephala Grun.	0.2				t
N. palea (Kutz.) W. Sm.		0.4			
N. paleacea Grun.					0.2

continued.

TAXA	3/21/77	4/20/77	7/19/77		7/20/77
	SC3	SC4	SC1	SC2	SC3
N. recta Hantz.	t	0.6	0.2	0.2	
N. sp. #1	4.5	t			0.4
Pinnularia braunii var. *amphicephala* (A. Mayer) Hust.					0.2
P. hilseana Jan.		t			
P. sp. #2				t	
Surirella linearis var. *constricta* (Ehr.) Grun.	t				
Synedra acus Kutz.		0.4			
S. minuscula Grun.	t	1.2		0.2	0.5
S. rumpens Kutz.	t	t	0.2	0.2	
S. ulna (Nitz.) Ehr.	t	4.4		t	0.2
S. sp.				0.2	

t = trace; indicates that taxon was observed in the floristic scan but not encountered in the proportional count.

X indicates that taxon was observed in the sample but not distinguished from the normal form or nominate variety in the proportional count.

APPENDIX M

Macroinvertebrate Data

STATION DATE	Stanley Creek below Fairway Creek 10/20/77						Lake Creek below Stanley Creek 10/20/77						Lake Creek above Porcupine Creek 10/20/77						Stanley Creek below Fairway Creek 07/20/77						Lake Creek below Stanley Creek 07/20/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q
Organism																														
Plecoptera																														
Perlidae																														
Acroneuria sp.						Q	11	4	5	9	3	Q	4		2	5	2	Q						Q				1	1	Q
Claassenia sp.							3	1	1			Q			1	1		Q							1					Q
Perlodidae																														
Isoperla sp.													1				2	Q												
Isogenus sp.				1		Q				1	4	Q	5	2	6	5	6	Q	2	1		1	1	Q						
Arcynopteryx sp.	4	5	7	14	9	Q					5	Q												Q	3			1	1	Q
Chloroperlidae																														
Paraperla sp.	1		2	1		Q																								
Alloperla sp.	13	4	19	5	8	Q	3		1	4		Q	1		2	3	3	Q				1		Q	1	1				Q
Hastaperla sp.	2		1	2	1	Q	1			1	1	Q																		
Nemouridae																														
Nemoura sp.	8	5	24	19	12	Q		1		1		Q	3		15	9	8	Q	1			1	2	Q						
Brachyptera sp.																														
Pteronarcidae																														
Pteronarcys sp.							4			1		Q					1	Q												
Peltoperlidae																														
Peltoperla sp.																														
Ephemeroptera																														
Heptageniidae																														
Cinygmula sp.	4	5	31	36	18	Q	16	14	5	19	5	Q	10	1	11	17	1	Q	34	6	16	14	6	Q						
Rhithrogena sp.	63	21	22	48	29	Q	10	11	14	13	2	Q	17	10	47	28	36	Q	7	[illegible]	14	5	1	Q	5	5		5		Q
Iron sp.																			2		1		1	Q		1	1	1		Q
Ironopsis sp.																					1			Q						
Baetidae																														
Ephemerella sp.	34	52	73	86	41	Q	12	6	2	16	8	Q	23	19	21	30	22	Q	18	9	19	21	18	Q	13	14	7	7	12	Q
Baetis sp.	5	3	14	15	1	Q		1		2		Q	1	1	2	2	5	Q	2					Q	2	2		1		Q
Paraleptophlebia sp.								2		3		Q		1			1	Q												
Ameletus sp.																														
Pseudocloeon sp.																	1	Q							4	2		1		Q
Trichoptera																														
Hydropsychidae																														
Hydropsyche sp.							47	55	3	54	86	Q	114	68	92	71	53	Q							2	5	2	4	3	Q
Arctopsyche sp.	7	7	14	27	14	Q		1		1	1	Q	1	1	1	2	5	Q		1				Q						
Parapsyche sp.	6	5	7	9	1	Q													2		4	1		Q						
Rhyacophilidae																														
Rhyacophila sp.	6	1	8	7	5	Q		2		5	4	Q	17	6	12	7	3	Q	7	2	7	3	4	Q			1		2	Q
Glossosoma sp.	11	7	14	15	9	Q	33	44	7	45	13	Q	15	19	18	26	17	Q	23	5	5	3		Q	3	8	2	12		Q
Agapetus sp.																														
Brachycentridae																														
Brachycentrus sp.													1		2	1	2	Q									1	1	8	Q
Micrasema sp.																														
Limnephilidae																														
Neophylax sp.			1	1	1	Q										2		Q												
Pycnopsyche sp.			2			Q																								
Lepidostomatidae																														
Lepidostoma sp.	5	4	4	6	4	Q								2		1	1	Q												
Philopotamidae																														
Sortosa sp.	1		1			Q																								
Hydroptilidae																														
Agraylea sp.													1					Q												
Coleoptera																														
Elmidae																														
Gonielmis sp.			2	1		Q	2	7	2	10	3	Q													8	8			6	Q
Heterlimnius sp.		3	2	4		Q		4	1	3	B	Q										1		Q	4	4	1		4	Q
Narpus sp.										1		Q														2		2	3	Q
Dytiscidae																														
Diptera																														
Tipulidae																														
Hexatoma sp.							2	3		6	1	Q			1	1		Q							1	1	2		2	Q
Dicranota sp.	1	1			1	Q				1		Q	3		2		1	Q												
Antocha sp.											3	Q	7	1	2			Q					1	Q		2	2		1	Q
Triogma sp.																	1	Q												
Psychodidae																														
Pericoma sp.																														
Empididae	1		1	2	1	Q													1		1		1	Q	1					Q
Simuliidae																														
Simulium sp.								1				Q		1				Q												
Ceratopogonidae																														
Bezzia sp.																														
Chironomidae																														
Tanypodinae																														
Ablabesmyia sp.													1					Q												
Chironominae																														
Micropsectra sp.	1		2	1		Q	2	2		3	6	Q	21	7	20	3	14	Q	3	3	4	4	3	Q	3	4		7	51	Q

STATION DATE	Lake Creek above Porcupine Creek 07/20/77						Stanley Creek at bridge near mouth 04/20/77						Lake Creek below Stanley Creek 04/20/77						Lake Creek above Porcupine Creek 04/19/77						Stanley Creek below Fairway Creek 03/21/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q
Organism																														
Plecoptera																														
Perlidae																														
Acroneuria sp.	1		1			Q								1				Q	1					Q						
Claassenia sp.																		Q												
Perlodidae																														
Isoperla sp.													2	7	2			Q	1	2	4		2	Q						
Isogenus sp.				1		Q		1	1		1	Q									3	1		Q						
Arcynopteryx sp.									1		1	Q	3					Q							1	1	1	1	2	
Chloroperlidae																														
Paraperla sp.																														
Alloperla sp.			1		1	Q		1				Q	3	16	8	5		Q	3	4	11	1	2	Q	2		1	2	1	
Hastaperla sp.																														
Nemouridae																														
Nemoura sp.								1		1		Q																		
Brachyptera sp.																														
Pteronarcidae																														
Pteronarcys sp.													1					Q			1			Q						
Peltoperlidae																														
Peltoperla sp.									1		3	Q																		
Ephemeroptera																														
Heptageniidae																														
Cinygmula sp.	1					Q	16	12	4	6	12	Q	22	47	20	19	3	Q	16	14	18	5	12	Q	2	6	5	4	7	
Rhithrogena sp.	1		2			Q		2	1	5		Q	7	25	12	7	4	Q					1	Q	25	14	17	11	24	
Iron sp.	1					Q													2	1	1	3		Q						
Ironopsis sp.	1					Q																1		Q						
Baetidae																														
Ephemerella sp.	25	5	9	13	2	Q	11	26	37	26	31	Q	12	27	21	15	16	Q	20	26	23	31	15	Q	3	5	8	3	6	
Baetis sp.	1	1	3	1		Q	1	2	4	3	2	Q	2	2	1	1	1	Q	2	7	3	4	10	Q	2	2			3	
Paraleptophlebia sp.													2	2		4		Q		1	3		1	Q						
Ameletus sp.							1	1				Q	2					Q												
Pseudocloeon sp.	3		3	2		Q																			3	1			3	
Trichoptera																														
Hydropsychidae																														
Hydropsyche sp.	12	3	8	B		Q							6	56	17	3	15	Q	32	71	73	25	26	Q						
Arctopsyche sp.	1			1		Q			1			Q						Q	3	1	1			Q	1	1	1	4		
Parapsyche sp.							1			1	2	Q															1		1	
Rhyacophilidae																														
Rhyacophila sp.	2	2	1	2	1	Q	5	2	2	3	3	Q		1			2	Q			3	4	2	Q	2	2	2		1	
Glossosoma sp.	4	23	3	5		Q				1		Q		1	2	1	6	Q	3	8	4	1		Q	1	1	5	1	2	
Agapetus sp.																			1					Q						
Brachycentridae																														
Brachycentrus sp.		17	2	2		Q			1			Q			1	1	1	Q		4	6			Q						
Micrasema sp.								1	5	5	4	Q							1	1	1			Q						
Limnephilidae																														
Neophylax sp.																			1		4	1	1	Q						
Pycnopsyche sp.																														
Lepidostomatidae																														
Lepidostoma sp.									6	7	7	Q																		
Philopotamidae																														
Sortosa sp.																														
Hydroptilidae																														
Agraylea sp.																														
Coleoptera																														
Elmidae																														
Gonielmis sp.			1			Q																								
Heterlimnius sp.				1		Q	1	3	4		2	Q	4	9	15		2	Q												
Narpus sp.			1			Q	3	9	8	5	6	Q		2				Q			1			Q						
Dytiscidae													5	2	1	3	1	Q												
																								Q						
Diptera																														
Tipulidae																														
Hexatoma sp.								1				Q	1	4	2	2	1	Q			1			Q						
Dicranota sp.			2			Q				1		Q							3	1				Q						
Antocha sp.	1	1	1	2		Q												Q		2		1		Q						
Triogma sp.																		Q												
Psychodidae																														
Pericoma sp.													2					Q												
Empididae	1			1		Q	4	5	5	3	1	Q		1				Q			1	1		Q						
Simuliidae																														
Simulium sp.																1		Q		1				Q	1					
Ceratopogonidae																														
Bezzia sp.		2				Q				2		Q																		
Chironomidae																														
Tanypodinae																														
Ablabesmyia sp.																														
Chironominae								2		1		Q		51	6	3	3	Q	32	21	32	4	11	Q	1					
Micropsectra sp.	10	5	2B	23	6	Q		1		2		Q		7				Q	1	4	5		1	Q						

STATION DATE	Lake Creek below Fairway Creek 03/21/77						Stanley Creek below Fairway Creek 02/09/78						Lake Creek below Stanley Creek 02/08/78						Lake Creek above Porcupine Creek 02/10/78					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q	1	2	3	4	5	Q
Organism																								
Plecoptera																								
Perlidae																								
Acroneuria sp.													2	1		10		Q	1	5		3	2	Q
Claassenia sp.	1				1													Q		1				Q
Perlodidae																								
Isoperla sp.													3	4	9	8	5	Q			1	3	5	Q
Isogenus sp.							2		1	3	3	Q					1	Q	6	5	7	10	11	Q
Arcynopteryx sp.									14	11	9	Q	1	9	14	3	4	Q						Q
Chloroperlidae																								
Paraperla sp.									2	1		Q												
Alloperla sp.	1	2	4				4	5	19	22	7	Q	2	14	9	11	11	Q	1	3	3	3	7	Q
Hastaperla sp.									1	2		Q											2	Q
Nemouridae																								
Nemoura sp.							18	10	39	38	27	Q	2					Q					3	Q
Brachyptera sp.							4	2	7	8	6	Q							2	1	1	3	1	Q
Pteronarcidae																								
Pteronarcys sp.													3					Q					2	Q
Peltoperlidae																								
Peltoperla sp.										1		Q												
Ephemeroptera																								
Heptageniidae																								
Cinygmula sp.	7	5	5	2	1		1		4	2	3	Q	19	78	62	32	81	Q	59	6	27	29	39	Q
Rhithrogena sp.	16	29	17	12	1		49	47	51	71	55	Q	3	11	12	17	12	Q	2	18	41	75	86	Q
Iron sp.			2		1		4		5	1	6	Q						Q				1		Q
Ironopsis sp.											1	Q												
Baetidae																								
Ephemerella sp.	3	4	1	1	1		32	15	39	36	31	Q	114	25	13	39	37	Q	27	17	10	11	29	Q
Baetis sp.	2	1	1				3	4	2	2	4	Q	2	1	6	2	1	Q	12	25	11	9	28	Q
Paraleptophlebia sp.											1	Q	2	3	1		4	Q	3	1	2	1	2	Q
Ameletus sp.									3			Q												
Pseudocloeon sp.								1	1		2	Q						Q			1			Q
Trichoptera																								
Hydropsychidae																								
Hydropsyche sp.	6	5	1	4	1								196	9	5	14	11	Q	5	39	7	10	37	Q
Arctopsyche sp.							13	3	26	20	17	Q	3					Q		2		1	1	Q
Parapsyche sp.							5	5	9	4	18	Q												
Rhyacophilidae																								
Rhyacophila sp.	1						1		3	7	8	Q	9			2		Q	7	5	3	4	10	Q
Glossosoma sp.	6	4	8	10	1		5	2	5	3	4	Q	25	2	4	23	5	Q	3	16	2	10	13	Q
Agapetus sp.																								
Brachycentridae																								
Brachycentrus sp.					1								15	2		1		Q					1	Q
Micrasema sp.																								
Limnephilidae																								
Neophylax sp.									1			Q												
Pycnopsyche sp.									1	1		Q	2					Q						
Lepidostomatidae																								
Lepidostoma sp.							1		3	6	3	Q											1	Q
Philopotamidae																								
Sortosa sp.																								
Hydroptilidae																								
Agraylea sp.														1	1			Q		1	1			Q
Coleoptera																								
Elmidae																								
Gonielmis sp.																								
Heterlimnius sp.										1	1	Q	18	8	11	6	5	Q	1	1		1		Q
Narpus sp.								1				Q	5	2	2	3	1	Q						
Dytiscidae																								
Diptera																								
Tipulidae																								
Hexatoma sp.													4	3	2	4	3	Q	1					Q
Dicranota sp.										2		Q	2					Q						
Antocha sp.					1								5			2		Q		1		1		Q
Triogma sp.																								
Psychodidae																								
Pericoma sp.																								
Empididae							1	1				Q				1	2	Q		1				Q
Simuliidae																								
Simulium sp.														3	1			Q		2			5	Q
Ceratopogonidae																								
Bezzia sp.																	2	Q						
Chironomidae																								
Tanypodinae																								
Ablabesmyia sp.											1	Q											1	Q
Chironominae	1						1			1	1	Q	28	9	13	87	38	Q	39	69	31	13	54	Q
Micropsectra sp.													5		1	12	3	Q	2	7	3	1	4	Q

Page 2 (continued)

STATION DATE	Stanley Creek below Fairway Creek 10/20/77						Lake Creek below Stanley Creek 10/20/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.										1	1	Q
Orthocladiinae												
Cricotopus sp.	3	2	4	6	2	Q	2	1	2	3	4	Q
Eukiefferiella sp.	1	1	2	3	2	Q					1	Q
Psectrocladius sp.				1		Q	1	1		1	2	Q
Cardiocladius sp.											1	Q
Thienemanniella sp.												
Smittia sp.												
Orthocladius sp.			1	2	2	Q					1	Q
Diamesinae												
Pseudodiamesa sp.												
Turbellaria	1	2	2	1	1	Q	1	1		1	1	Q
Annelida												
Oligochaeta	8	5	10	11	6	Q	3	8		3	2	Q
Pelecypoda										1	1	Q
Gastropoda											1	Q
Porifera												
Hydracarina	1					Q						
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	186	133	271	324	168		154	170	42	209	168	
No. Taxa/ft.^{2}	22	18	27	26	21		18	21	11	27	26	
No. Animals/5 ft.^{2}	1082						743					
No. Taxa/5ft.^{2}	30						35					
Tolerant Animals (%)	0						0					
Facultative Animals (%)	7.0						9.7					
Intolerant Animals (%)	93.0						90.3					

STATION DATE	Lake Creek above Porcupine Creek 10/20/77						Stanley Creek below Fairway Creek 07/20/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.	33	2	18	1	5	Q						
Orthocladiinae												
Cricotopus sp.	1	1	2	2	6	Q	7	1	1	8	6	Q
Eukiefferiella sp.	4			1	2	Q	4	2	3	1	7	Q
Psectrocladius sp.	2			1	2	Q				3	1	Q
Cardiocladius sp.	2	1	1			Q	1				1	Q
Thienemanniella sp.												
Smittia sp.												
Orthocladius sp.	2	1			1	Q				1	5	Q
Diamesinae												
Pseudodiamesa sp.										1	2	Q
Turbellaria			1	2		Q		1			2	Q
Annelida												
Oligochaeta	3		2	3	11	Q	11	4	5	8	5	Q
Pelecypoda	1			1		Q						
Gastropoda												
Porifera												
Hydracarina												
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	294	144	281	234	242		125	38	81	77	67	
No. Taxa/ft.^{2}	27	18	23	25	27		16	12	13	17	18	
No. Animals/5 ft.^{2}	1195						388					
No. Taxa/5ft.^{2}	37						25					
Tolerant Animals (%)	0						0					
Facultative Animals (%)	9.2						5.4					
Intolerant Animals (%)	90.8						94.6					

STATION DATE	Lake Creek below Stanley Creek 07/20/77						Lake Creek above Porcupine Creek 07/20/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.	1				5	Q	4	1	6	4		Q
Orthocladiinae												
Cricotopus sp.	1	1	1			Q	5	1		2	1	Q
Eukiefferiella sp.							3		1		1	Q
Psectrocladius sp.				1		Q	1	3	1	1	2	Q
Cardiocladius sp.								1		1		Q
Thienemanniella sp.								1				Q
Smittia sp.												
Orthocladius sp.								2	3		2	Q
Diamesinae												
Pseudodiamesa sp.					2	Q						
Turbellaria					1	Q						
Annelida												
Oligochaeta	2				1	Q	1		3			Q
Pelecypoda												
Gastropoda												
Porifera												
Hydracarina												
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	55	60	20	44	103		79	68	75	71	18	
No. Taxa/ft.^{2}	17	15	10	13	16		20	15	19	17	9	
No. Animals/5 ft.^{2}	282						311					
No. Taxa/5ft.^{2}	26						31					
Tolerant Animals (%)	0						0.4					
Facultative Animals (%)	16.2						37.2					
Intolerant Animals (%)	83.8						62.4					

STATION DATE	Stanley Creek at bridge near mouth 04/20/77						Lake Creek below Stanley Creek 04/20/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.	3	16	1			Q		2				Q
Orthocladiinae		16	13	15	5	Q						
Cricotopus sp.			2	1		Q		2				Q
Eukiefferiella sp.		1				Q						
Psectrocladius sp.												
Cardiocladius sp.		5	11	10	8	Q						
Thienemanniella sp.		1				Q						
Smittia sp.												
Orthocladius sp.		2	3	3	2	Q						
Diamesinae												
Pseudodiamesa sp.		1	5	2	1	Q	3	8	3	1		Q
Turbellaria		2	4	6	1	Q			2			Q
Annelida												
Oligochaeta												
Pelecypoda												Q
Gastropoda												Q
Porifera												
Hydracarina												Q
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	46	114	120	107	94		77	273	113	66	55	
No. Taxa/ft.^{2}	10	24	22	21	19		16	21	15	14	12	
No. Animals/5 ft.^{2}	481						584					
No. Taxa/5ft.^{2}	34						28					
Tolerant Animals (%)	0.3						0					
Facultative Animals (%)	11.8						21.3					
Intolerant Animals (%)	87.9						78.7					

STATION DATE	Lake Creek above Porcupine Creek 04/19/77						Stanley Creek below Fairway Creek 03/21/77					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.	1	1	3	1	1	Q						
Orthocladiinae	1	2	1	1		Q						
Cricotopus sp.	3		1			Q						
Eukiefferiella sp.		1				Q						
Psectrocladius sp.			1			Q						
Cardiocladius sp.												
Thienemanniella sp.												
Smittia sp.												
Orthocladius sp.			1			Q						
Diamesinae												
Pseudodiamesa sp.		1				Q	3		5	1	2	
Turbellaria		3	2		1	Q						
Annelida												
Oligochaeta												
Pelecypoda												
Gastropoda												
Porifera												
Hydracarina												
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	127	177	208	85	86		47	33	46	27	52	
No. Taxa/ft.^{2}	19	21	27	16	14		13	9	10	8	11	
No. Animals/5 ft.^{2}	683						205					
No. Taxa/5ft.^{2}	36						14					
Tolerant Animals (%)	0						0.6					
Facultative Animals (%)	6.4						12.2					
Intolerant Animals (%)	93.6						87.2					

STATION DATE	Lake Creek below Fairway Creek 03/21/77						Stanley Creek below Fairway Creek 02/09/78					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.							6	5	16	9	7	Q
Orthocladiinae							2	2	3	1	3	Q
Cricotopus sp.							4	2	6	5	5	Q
Eukiefferiella sp.												
Psectrocladius sp.												
Cardiocladius sp.												
Thienemanniella sp.							1	1	3	1	2	Q
Smittia sp.												
Orthocladius sp.									1			Q
Diamesinae												
Pseudodiamesa sp.									3	2	2	Q
Turbellaria							4	1	11	9	7	Q
Annelida												
Oligochaeta												
Pelecypoda												
Gastropoda												
Porifera												
Hydracarina												
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	43	51	36	33	9		160	107	280	270	234	
No. Taxa/ft.^{2}	9	8	7	5	9		20	67	29	28	27	
No. Animals/5 ft.^{2}	172						1051					
No. Taxa/5ft.^{2}	13						37					
Tolerant Animals (%)	0						0					
Facultative Animals (%)	0.6						5.5					
Intolerant Animals (%)	99.4						94.5					

STATION DATE	Lake Creek below Stanley Creek 02/08/78						Lake Creek above Porcupine Creek 02/10/78					
Sample Number	1	2	3	4	5	Q	1	2	3	4	5	Q
Diptera												
Rheotanytarsus sp.	15	6	10	14	26	Q	35	7	4	4	2	Q
Orthocladiinae	3	1	7	3	5	Q						
Cricotopus sp.	8	3	4	4	10	Q	1					Q
Eukiefferiella sp.	1		1	2	3	Q	11	6	2	1		Q
Psectrocladius sp.												
Cardiocladius sp.												
Thienemanniella sp.	4	1	2	2	3	Q	47	6	3	6	4	Q
Smittia sp.												
Orthocladius sp.	4		1	7	9	Q	3	1	1			Q
Diamesinae												
Pseudodiamesa sp.	7	14	18	5	10	Q					1	Q
Turbellaria	6	8	8	3	2	Q	4	2	6	5	5	Q
Annelida												
Oligochaeta	2	1		2	3	Q						
Pelecypoda	1			1	4	Q						
Gastropoda												
Porifera												
Hydracarina												
Hemiptera												
Corixidae												
No. Animals/ft.^{2}	521	219	217	320	301		272	248	168	205	355	
No. Taxa/ft.^{2}	34	25	25	29	28		22	26	22	23	26	
No. Animals/5 ft.^{2}	1578						1248					
No. Taxa/5ft.^{2}	39						38					
Tolerant Animals (%)	0						.2					
Facultative Animals (%)	14.8						5.6					
Intolerant Animals (%)	85.2						94.2					

APPENDIX N

In Situ Bioassay in Stanley and Lake Creek

STATE OF MONTANA
DEPARTMENT OF FISH AND GAME
HELENA, MONTANA

Office Memorandum

TO : Loren Bahls, Water Quality Bureau **DATE:** October 27, 1977

FROM : Kurt Hill, Department of Fish & Game

SUBJECT: In-situ bioassay in Stanley and Lake Creeks

An in-situ bioassay using cutthroat trout from the Flathead Lake Salmon Hatchery in Somers, Montana was conducted October 18th through 21st 1977 in the Bull Lake area near Troy, Montana. Fingerlings averaging about 6cm in length were transported in an aerated tank to the Bull Lake area and were placed in livecars at 4 stations.

Station 1 was located on Lake Creek about 2 kilometers below its confluence with Camp Creek. Station 2 was located on Stanley Creek near the bridge that crosses Stanley Creek about ½ kilometer above its confluence with Thicket Creek. Station 3 was located about 4 kilometers upstream from Station 2 on Stanley Creek. Station 4 was located about 20 meters below the north exploratory adit near the top of the Stanley Creek Drainage.

Ten fish were placed in a nylon mesh flow-thru livecar at each station. At stations 1, 2 and 3 livecars were placed directly in the stream but at station 4 a small temporary pond was created using a plastic wading pool to accomodate the livecar. A portion of the flow coming from the adit was directed thru the artificial pond. Water samples were collected at each station at the time fish were placed in the livecars and each day thereafter until the fish were removed on the 21st of October. A dead fish was removed from the livecar at station 2 on the 19th of October. This was the only mortality of any of the 4 stations during the 65 hour assay. Water temperatures were recorded for stations 1 and 2 on the 18th of October and all 4 stations on the 21st of October.

Soon after removal from the livecars the fish were frozen and then weighed and measured in the laboratory. Wet weight and length of the fish, water temperatures, date and time of planting and removal of the livecars, and legal descriptions of the locations of the 4 stations are listed below.

KH/dew

	STATION LOCATION	TIME IN	TEMP	TIME OUT	TEMP	TIME ELAPSED	MORTALITIES
1	30N33W31AC	10-18 1500 hrs.	8.5^{o}C	10-21 800 hrs.	9^{o}C	65 hrs.	0
2	29N34W3BAD	10-18 1600 hrs.	9.0^{o}C	10-21 900 hrs.	9^{o}C	65 hrs.	1
3	29N34W26DA	10-18 1930 hrs.	-	10-21 1200 hrs.	10^{o}C	64.5 hrs.	0
4	29N34W35AB	10-18 1800 hrs.	-	10-21 1000 hrs.	9^{o}C	64 hrs.	0

30N33W31AC
Station 1

Weight gms	Length cms
1.48	5.3
2.00	6.0
2.18	6.0
1.92	5.9
1.15	5.0
1.66	5.4
2.04	5.9
1.41	5.2
2.55	6.5
1.58	5.5
Ave. 1.79	Ave. 5.67

29N34W13BAD
Station 2

Weight gms	Length cms
1.71	5.7
1.81	5.5
2.00	6.1
2.20	6.1
2.71	6.5
2.28	6.5
1.25	5.3
1.64	5.7
1.70	5.7
1.81	5.7*
Ave. 1.91	Ave. 5.88

29N34W26DA
Station 3

Weight gms	Length cms
1.80	5.8
1.79	5.8
2.06	6.1
2.40	6.4
1.62	5.6
1.81	5.7
1.91	5.8
2.44	6.5
1.32	5.3
1.83	5.9
Ave. 1.89	Ave. 5.89

29N34W35AB
Station 4

Weight gms	Length cms
1.54	5.3
2.04	6.0
1.95	6.0
1.98	6.1
3.12	6.7
2.23	6.1
1.17	5.6
2.10	5.9
1.62	5.5
1.65	5.5
Ave. 1.94	Ave. 5.87

* = Mortality

APPENDIX O

1) Terrestrial Fauna Tables
2) Statement of Work for USFS Grizzly Bear Contract with Olson and Elliot
3) Grizzly Bear Study Habitat Components

Bird species observed according to month on the ASARCO copper-silver mine study area from April 1977 through March 1978

COMMON NAME	SCIENTIFIC NAME	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
Common Loon	*Gavia immer*								x				
Red-necked Grebe	*Podiceps grisegena*								x				
Horned Grebe	*Podiceps auritus*	x											
Western Grebe	*Aechmophorus occidentalis*							x	x				
Pied-billed Grebe	*Podilymbus podiceps*								x				x
Great Blue Heron	*Ardea herodias*	x		x	x	x	x		x				
Whistling Swan	*Olor columbianus*	x								x			
Canada Goose	*Branta canadensis*	x											
Mallard	*Anas platyrhynchos*	x	x	x	x	x		x	x				x
Pintail	*Anas acuta*	x											
Green-winged Teal	*Anas crecca*	x											
Blue-winged Teal	*Anas discors*			x	x			x					
Cinnamon Teal	*Anas cyanoptera*	x						x	x				
American Wigeon	*Mareca americana*	x						x					
Ring-necked Duck	*Aythya collaris*		x	x	x				x				
Common Goldeneye	*Bucephala clangula*	x	x	x	x								x
Barrow's Goldeneye	*Bucephala islandica*								x				
Common Merganser	*Mergus merganser*	x			x	x			x				
Hooded Merganser	*Lophodytes cucullatus*							x		x			
Bufflehead	*Bucephala albeola*							x					
Goshawk	*Accipiter gentilis*			x		x							
Sharp-shinned Hawk	*Accipiter straiatus*					x							
Cooper's Hawk	*Accipiter cooperii*	x											
Red-tailed Hawk	*Buteo jamaicensis*	x	x	x		x	x						
Rough-legged Hawk	*Buteo lagopus*					x							
Bald Eagle	*Haliaeetus leucocephalus*	x							x			x	
Marsh Hawk	*Circus cyaneus*	x											
Golden Eagle	*Aquila chrysaetos*		x			x							

Table (continued)

COMMON NAME	SCIENTIFIC NAME	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
Osprey	*Pandion haliaetus*	x	x	x	x	x	x						
Merlin	*Falco columbarius*				x	x							
American Kestrel	*Falco sparverius*		x	x	x	x	x						
Blue Grouse	*Dendragapus obscurus*		x	x	x	x		x					x
Spruce Grouse	*Canachites canadensis*								x				
Ruffed Grouse	*Bonasa umbellus*	x	x	x	x	x	x	x	x	x	x		
American Coot	*Fulica americana*	x											
Killdeer	*Charadrius vociferus*	x											
Common Snipe	*Capella gallinago*	x		x	x								
Spotted Sandpiper	*Actitis macularia*			x	x	x							
California Gull	*Larus californicus*					x	x						
Rock Dove	*Columba livia*	x											
Mourning Dove	*Zenaida macroura*		x	x	x	x							
Great Horned Owl	*Bubo virginianus*		x								x		
Great Gray Owl	*Strix nebulosa*					x		x					
Saw-whet Owl	*Aegolius acadicus*					x							
Barred Owl	*Strix varia*					x							
Common Nighthawk	*Chordeiles minor*			x	x	x							
Calliope Hummingbird	*Stellula calliope*				x								
Black-chinned Hummingbird	*Archilochus alexandri*				x	x							
Rufous Hummingbird	*Selasphorus rufus*		x	x	x	x							

Table (continued)

COMMON NAME	SCIENTIFIC NAME	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
Belted Kingfisher	*Megaceryle alcyon*	x			x	x	x		x				
Common Flicker	*Colaptes auritus*	x	x	x	x	x	x	x					
Pileated Woodpecker	*Dryocopus pileatus*	x	x			x					x		
Lewis' Woodpecker	*Asyndesmus lewis*			x	x	x							
Yellow-bellied Sapsucker	*Sphyrapicus varius*	x	x	x									
Hairy Woodpecker	*Dendrocopus villosus*		x	x							x		
Downy Woodpecker	*Dendrocopus pubescens*								x				
Empidonax Flycatchers	*Empidonax* spp.			x									
Olive-sided Flycatcher	*Nuttallornis borealis*					x							
Violet-green Swallow	*Tachycineta thalassina*			x	x								
Tree Swallow	*Iridoprocne bicolor*	x			x								
Bank Swallow	*Riparia riparia*	x											
Rough-winged Swallow	*Stelgidopteryx ruficollis*			x	x	x							
Barn Swallow	*Hirundo rustica*		x	x	x	x							
Steller's Jay	*Cyanocitta stelleri*			x		x	x	x	x	x			
Gray Jay	*Perisoreus canadensis*			x	x	x		x			x		x
Clark's Nutcracker	*Nucifraga columbiana*			x	x	x	x	x		x	x		
Common Raven	*Corvus corax*		x	x	x	x	x	x	x		x		
Common Crow	*Corvus brachyrhynchos*	x	x	x	x	x	x	x	x	x	x	x	x
Black-capped Chickadee	*Parus atricapillus*	x	x	x	x	x	x		x	x	x	x	
Mountain Chickadee	*Parus gambeli*	x	x	x	x	x	x		x	x	x		
Chestnut-backed Chickadee	*Parus rufescens*			x							x		

Table continued

COMMON NAME	SCIENTIFIC NAME	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
Dipper	*Cinclus mexicanus*	x	x	x	x	x	x		x				x
Red-breasted Nuthatch	*Sitta canadensis*		x	x					x		x		
Brown Creeper	*Certhia familiaris*							x					x
Winter Wren	*Troglodytes troglodytes*								x				x
American Robin	*Turdus migratorius*	x	x	x	x	x	x						x
Varied Thrush	*Ixoreus naevius*	x	x	x		x		x					x
Townsend's Solitaire	*Myadestes townsendi*		x	x	x	x							
Hermit Thrush	*Catharus guttatus*			x									
Swainson's Thrush	*Catharus ustulatus*		x	x									
Veery	*Catharus fuscescens*	x	x	x									
Mountain Bluebird	*Sialia currucoides*	x	x	x	x	x	x						x
Golden-crowned Kinglet	*Regulus satrapa*		x	x							x		x
Ruby-crowned Kinglet	*Regulus calendula*		x					x					
Water Pipit	*Motacilla spinoletta*			x									
Bohemian Waxwing	*Bombycilla garrulus*			x									
Cedar Waxwing	*Bombycilla cedrorum*				x								
Starling	*Sturnus vulgaris*		x	x	x	x							
Red-eyed Vireo	*Vireo olivaceus*				x								
Yellow Warbler	*Dendroica petechia*			x	x								
Yellow-rumped Warbler	*Dendroica coronata*	x	x	x									
Townsend's Warbler	*Dendroica townsendi*					x							
Common Yellowthroat	*Geothlypis trichas*			x									
MacGillivray's Warbler	*Oporornis tolmiei*	x											
American Redstart	*Setophaga ruticilla*				x								

Table (continued)

COMMON NAME	SCIENTIFIC NAME	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
Western Meadowlark	*Sturnella neglecta*					x	x						
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*		X										
Red-winged Blackbird	*Agelaius phoeniceus*	x											
Brewer's Blackbird	*Euphaga cyanocephalus*	x											
Western Tanager	*Piranga ludoviciana*			x		X							
Evening Grosbeak	*Hesperiphona vespertina*		x	x									
Pine Grosbeak	*Pinicola enucleator*		x	x							x		
Gray-crowned Rosy Finch	*Leucosticte tephrocotis*					x							
Pine Siskin	*Spinus pinus*	x				x							
Red Crossbill	*Loxia curvirostra*			x									
Dark-eyed Junco	*Junco hyemalis*	x	x	x	x	x	x	x	x				
Tree Sparrow	*Spizella arborea*	x											
Chipping Sparrow	*Spizella passerina*			x	x	x							
Fox Sparrow	*Passerella iliaca*	x											
Lincoln's Sparrow	*Melospiza lincolnii*					x							
Song Sparrow	*Melospiza melodia*	x	x	x	x								
White-crowned Sparrow	*Zonotrichia leucophrys*			x									

Appendix Table Bird species observed according to cover type and habitat type on the ASARCO copper-silver mine study area from April 1977 through March 1978

COMMON NAME	COVER TYPES						HABITAT TYPES[1]																					
	WATER	SHORE	SHRUBS	CUTTING UNITS	OPEN AREAS[2]	FOREST	THUJA-TSUGA[3] SERIES	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES GRANDIS SERIES	ABGR/CLUN	ABIES LASIOCARPA SERIES	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI	PSEUDOTSUEA MENZIESII SERIES	PSME/PHMA	PSME/LIBO	PSME/VAGL	PSME/SYAL	PSME/CARU	PSME/AGSP	PINUS CONTORTA COMMUNITIES	PICO/VACA
Common Loon	x																											
Red-necked Grebe	x																											
Horned Grebe	x																											
Western Grebe	x																											
Pied-billed Grebe	x																											
Great Blue Heron	x	x																										
Whistling Swan	x																											
Canada Goose	x																											
Mallard	x																											
Pintail	x																											
Green-winged Teal	x																											
Blue-winged Teal	x																											
Cinnamon Teal	x																											
American Widgeon	x																											
Ring-necked Duck	x																											
Common Goldeneye	x																											
Barrow's Goldeneye	x																											
Common Merganser	x																											
Hooded Merganser	x																											
Bufflehead	x																											
Goshawk						x				x											x							
Sharp-shinned Hawk						x										x												
Cooper's Hawk						x			x																			
Red-tailed Hawk				x	x				x	x									x	x	x				x	x		
Rough-legged Hawk				x		x			x																			
Bald Eagle					x	x			x	x																		
Marsh Hawk		x			x					x																		
Golden Eagle													x															
Osprey	x					x	x		x		x																	
Merlin					x	x							x				x											
American Kestrel				x	x	x													x							x		
Blue Grouse			x			x				x		x		x	x		x	x	x		x		x			x		
Spruce Grouse						x				x																		
Ruffed Grouse			x			x	x		x	x					x			x			x	x			x			
American Coot	x																											
Killdeer		x																										
Common Snipe		x																										
Spotted Sandpiper		x																										
California Gull	x				x	x							x															
Rock Dove						x				x																		
Mourning Dove					x																							
Great Horned Owl						x				x										x								
Barred Owl						x				x																		
Great Grey Owl						x				x																		
Saw-whet Owl						x							x															
Common Nighthawk						x				x															x			
Calliope Hummingbird			x																									
Black-chinned Hummingbird						x													x								x	
Rufous Hummingbird			x	x		x				x					x		x											

Table (continued)

	COVER TYPES						HABITAT TYPES[1/]																					
COMMON NAME	WATER	SHORE	SHRUBS	CUTTING UNITS	OPEN AREAS[2/]	FOREST	THUJA-TSUGA[3/] SERIES	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES GRANDIS SERIES	ABGR/CLUN	ABIES LASIOCARPA SERIES	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI	PSEUDOTSUEA MENZIESII SERIES	PSME/PHMA	PSME/LIBO	PSME/VAGL	PSME/SYAL	PSME/CARU	PSME/AGSP	PINUS CONTORTA COMMUNITIES	PICO/VACA
Belted Kingfisher	X																											
Common Flicker				X		X				X								X	X							X		
Pileated Woodpecker				X	X	X		X		X								X										
Lewis' Woodpecker				X																								
Yellow-bellied Sapsucker				X		X				X																		
Hairy Woodpecker				X		X				X									X							X		
Downy Woodpecker						X			X	X																		
Empidonax Flycatchers						X				X												X						
Olive-Sided Flycatcher				X						X																		
Violet-green Swallow				X	X																							
Tree Swallow				X	X																							
Bank Swallow				X	X																							
Rough-winged Swallow				X	X																							
Barn Swallow				X	X																							
Steller's Jay			X	X		X		X		X		X							X									
Gray Jay				X		X				X		X					X											
Clark's Nutcracker						X								X					X									
Common Raven			X	X	X	X		X		X				X	X													
Common Crow			X	X	X	X			X	X									X						X			
Black-capped Chickadee				X		X		X	X	X		X																
Mountain Chickadee						X				X		X				X		X										
Chestnut-backed Chickadee						X				X																		
Dipper	X	X				X		X		X																		
Red-Breasted Nuthatch						X				X				X	X	X												
Brown Creeper						X				X																		
Winter Wren			X			X		X		X																		
American Robin			X	X	X	X				X									X			X						
Varied Thrush						X		X		X						X		X					X					
Townsend's Solitaire			X	X		X				X									X									
Hermit Thrush						X											X						X					
Swainson's Thrush			X	X		X		X		X												X						
Veery			X			X				X																		
Mountain Bluebird				X	X																							
Golden-crowned Kinglet					X	X				X					X							X						
Ruby-crowned Kinglet						X				X					X							X						
Water Pipit			X	X																								
Bohemian Waxwing			X																									
Cedar Waxwing			X																									
Starling				X	X																							
Red-eyed Vireo						X																						
Yellow Warbler			X																			X						
Yellow-rumped Warbler				X		X				X									X									
Townsend's Warbler												X																
Common Yellowthroat			X																									
MacGillivray's Warbler						X				X																		
American Redstart						X				X																		

Table (continued)

	COVER TYPES						HABITAT TYPES[1]																					
COMMON NAMES	WATER	SHORE	SHRUBS	CUTTING UNITS	OPEN AREAS[2]	FOREST	THUJA-TSUGA[3] SERIES	THPL/OPHO	THPL/CLUN	TSHE/CLUN	ABIES GRANDIS SERIES	ABGR/CLUN	ABIES LASIOCARPA SERIES	ABLA/CLUN	ABLA/MEFE	ABLA/CACA	TSME/XETE	ABLA/XETE	ABLA/LUHI	PSEUDOTSUEA MENZIESII SERIES	PSME/PHMA	PSME/LIBO	PSME/VAGL	PSME/SYAL	PSME/CARU	PSME/AGSP	PINUS CONTORTA COMMUNITIES	PICO/VACA
Western Meadowlark					x																							
Yellow-headed Blackbird			x																									
Red-winged Blackbird			x																									
Brewer's Blackbird					x																							
Western Tanager						x													x			x						
Evening Grossbeak						x				x															x			
Pine Grosbeak						x				x					x		x											
Gray-crowned Rosy Finch					x	x													x									
Pine Siskin					x	x						x							x							x		
Red Crossbill						x									x													
Dark Eyed Junco				x		x		x			x	x							x						x			
Tree Sparrow			x																									
Chipping Sparrow						x				x	x				x				x						x			
Fox Sparrow			x	x		x		x																				
Lincoln Sparrow			x							x																		
Song Sparrow			x			x				x																		
White-crowned Sparrow			x																									

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[1] Habitat types according to Pfister et. al. (1977). The name of the habitat Series precedes each set of habitat types. Habitat type names are presented as standardized abbreviations

[2] Open areas include pastures, cropland and natural openings (including meadows, parks, talus and burns).

[3] Observation recorded by series if exact habitat type could not be determined or if species was universally distributed throughout series.

Appendix Table Small mammal trapline site information on the ASARCO copper-silver mine study area Spring and Fall 1977

NAME AND LOCATION	ELEVA-TION	ASPECT	HABITAT TYPE[2/]	SITE DESCRIPTION
Tailings Pond Site NE1/4 NE1/4 S31 T30N R33W	700	None	TSHE/CLUN	0.35 Km south of Little Joe, Mt. turn west go 2.25 Km into large clearcut. 70 m east of road. Line set at S50°E. Clearcut, broadcast burn.
Well and Substation Site SE1/4 NE1/4 S13 T29N R34W	780	North	TSHE/CLUN	0.3 Km south of Stanley Creek bridge. 45 m east of road. Line set at N45°E. Clearcut 13 years old, broadcast burn.
Clarification Pond Site[3/] SE1/4 NW1/4 S13 T29N R34W	780	North	TSHE/CLUN	0.4 Km south of Stanley Creek bridge. 15 m west of road. Line set at W10°N. Timbered, undisturbed area.
Lower Mill Site NE1/4 NE1/4 S26 T29N R34W	1060	North	TSHE/CLUN	6.75 Km south of Stanley Creek bridge. 27 m south of road. Line set at S40°E. Last year's selection cut, thick slash and debris. Slash had been piled by fall trap period.
Upper Mill Site NE1/4 NE1/4 S26 T29N R34W	1160	Northeast	TSHE/CLUN and THPL/OPHO	7.7 Km south of Stanley Creek bridge. 50 m south of road up cut bank. Line set due south. Edge of selection cut. Timbered site. Moist areas dispersed throughout.
Thuja plicata/Oplopanax horridum habitat type SE1/4 NE1/4 S26 T29N R33W	1190	East	THPL/OPHO	8.2 Km south Stanley Creek bridge or, 6 Km N of Mt. Vernon Pass in dry creek bed. Line set at N80°W. Western hemlock, western red cedar and Douglas fir overstory with devil's club, thimbleberry and ferns understory.
Tsuga heterophylla/Clintonia uniflora habitat type SW1/4 NW1/4 S32 T30N R33W	715	None	TSHE/CLUN	About 0.35 Km south of Little Joe, Mt., on Highway 202 turn west, go 1.6 Km to abandoned cabin then 45 m beyond cabin toward pond. Line set due south. Western hemlock, grand fir, Douglas fir, lodge pole pine, ponderosa pine overstory with twinflower, pinegrass, buffalo berry and oceanspray understory.

Abies lasiocarpa/Menziesia ferruginea habitat type NW1/4 SW1/4 S36 T29N R33W	1675	Northwest	ABLA/MEFE	From Ross Creek-Stanley Creek pass on Mt. Vernon, east 0.5 Km then north 0.2 Km then 30 m north of bend in road. Line set due east. Subalpine fir, Douglas fir, spruce forest having microsites of ABLA/CACA.

1/ Elevation in meters.

2/ See Appendix Table for full names of habitat types according to Pfister et al (1977).

3/ Plans for the clarification pond have been deleted by ASARCO. This site represents an undisturbed TSHE/CLUN habitat type.

Table Browse transect[1] information collected on redstem ceanothus (Ceanothus sanguineus), ASARCO copper-silver mine study area, 1977

Transect Location	Habitat Type[2]	Avg. Percent Leader Use	Hedging(percent)			Age Class % (resprout)			Pellet Groups	
			Little	Mod.	Severe	Young	Mature	Decadent	Deer	Elk
NW¼ NW¼ S18 T30N R33W Copper-Iron Creek Road (#384) 2.7Km N of Road Jct. 384 and 404. 38m W of Road N 40° W from point of beginning.	PSME/PHMA	40	8	92	-	4	64(32)	32(24)	0	0
NW¼ NW¼ S12 T29N R34W Keeler Mtn. Road 1.1Km from Spar Lake Road. 9.75m W of road edge. S 15° W from point of beginning.	TSHE/CLUN	22	8	92	-	-	88	12	1	1
NE¼ NE¼ S8 T28N R33W Ross Creek Road 1.0Km from Ross Creek Bridge. 15.25m N of road edge. N 75° W from point of beginning.	TSHE/CLUN	25	-	100	-	4	92	4	7	1

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[1] Technique followed Cole (1958).

[2] According to Pfister et. al. (1977). See Appendix Table for full scientific and common names.

Mountain lion observations and sign observed on the ASARCO copper-silver mine study area from 1974 to March 1978

DATE	LOCATION	TYPE OF REPORT	AGE	SEX	REMARKS
6/74[1]	Bull Lake	Track	Adult		
9/74	Callahan Creek	Track	Adult		
12/74	South Fork Bull River	Track	Adult		
12/74	Ross Creek	Tracks			Female with three kittens.
1/01/75	Thicket Creek	Treed	Adult		
1/01/75	Stanley Creek	Track	Adult		
1/02/75	Lake Creek	Kill	3-4 yrs.	Male	
1/75	Dry Creek	Track	Adult		
2/75	Callahan Creek	Kill	Adult	Female	
4/75	North Fork Bull River	Kill	Adult	Male	
10/75	Mount Vernon	Track	Adult		Large, probable male.
12/75	Ross Creek	Treed	Adult	Female	Pregnant.
1/01/76	South Fork Bull River	Track	Adult		Not the same lion as treed later in the day.
1/01/76	South Fork Bull River	Treed	Adult	Male	This lion accompanied by lion listed above.

DATE	LOCATION	TYPE OF REPORT	AGE	SEX	REMARKS
1/11/76	Lake Creek	Kill	Adult	Male	
1/11/76	Lake Creek	Observed	Adult	Female	In company with above male.
1/13/76	Taylor Mountain	Marked	Adult	Female	Tagged, #A99.
1/23/76	Emma Gulch	Treed	Adult	Female	#A99.
1/76	Stanley Creek	Treed	Adult	Male	Large.
1/76	Keeler Creek	Track	Adult		
2/76	South Fork Bull River	Marked	Adult	Female	Tagged, #2.
2/76	South Fork Bull River	Treed	Adult	Female	#2.
3/76	Keeler Mountain	Treed	Adult	Female	
3/76	Stanley Creek	Marked	Adult	Male	Tagged, #3.
3/76	Lake Creek	Treed	Adult and two kittens		Female with two kittens all were treed.
3/76	Lake Creek	Treed	Adult	Female	#A99.
3/76	Keeler Creek	Kill	Adult	Male	
5/76	Callahan Creek	Track	Adult		
5/76	Berray Mountain	Track	Adult		
12/76	Keeler Mountain	Track	Adult and two kittens		Female with two kittens.

DATE	LOCATION	TYPE OF REPORT	AGE	SEX	REMARKS
1/13/77	Keeler Mountain	Treed	Adult	Female	#A99.
4/77	Lake Creek	Scat			
5/13/77[2/]	Ross Creek	Scat			
5/13/77[2/]	Stanley Creek	Scat			
6/03/77[3/]	Mount Vernon - Spar Peak Ridge	Track			
8/12/77[3/]	Stanley Mountain	Scat			
11/19/77[3/]	Bull Lake-Spires	Track	Adult		
11/19/77[3/]	Bull Lake-Spires	Scrapes			Three piles of duff.
11/19/77[3/]	Bull Lake-Spires	Scat	Adult		
12/77	Keeler Mountain	Track			Female with two kittens.
12/05/77	North Fork Bull River	Treed	Adult	Female	
12/05/77	North Fork Bull River	Track	Adult		
12/16/77[3/]	Keeler Creek	Tracks			Female with two kittens.
12/17/77	Keeler Creek	Kill	Adult	Female	Kitten tracks in vicinity.
12/26/77	Ross Creek - Bull Lake	Kill	Adult	Male	
12/29/77[4/]	Keeler Creek	Treed	Two Kittens		

DATE	LOCATION	TYPE OF REPORT	AGE	SEX	REMARKS
1/06/78 3/	Keeler Creek and Keeler Mountain	Tracks	Two Kittens		
1/10/78	Stanley Creek	Track	Kitten		
1/22/78 3/	Taylor Mountain Road	Track	Adult		
1/23/78 3/	Camp Creek	Marked	Kitten	Female	
1/24/78 3/	Lake Creek	Track	Adult		Had killed whitetail buck.
03/04/78 5/	Dry Creek	Track	Adult		

1/ Unless otherwise noted, information provided by Ed Vance, houndsman and participant in Montana Department of Fish and Game mountain lion marking program.

2/ Provided by personnel of Olson, Elliott and Associates, Helena, Montana 59601.

3/ Noted by author.

4/ /Noted by G. Burk, Game Warden, Montana Department of Fish and Game.

5/ Noted by J. Brown, Biologist, Montana Department of Fish and Game.

Appendix Table Percentage of elk, deer and moose sign observed at different aspects, elevations, slopes, habitat types, distances to cover distances from road, topographies and configurations on the ASARCO copper-silver mine study area from October 1977 through March 1978

ASPECT	ELK (120)	DEER[1] (1013)[2]	MOOSE (61)
N	0	5	0
NE	6	5	18
E	13	19	13
SE	17	24	11
S	2	5	18
SW	1	3	0
W	18	13	2
NW	4	13	0
NONE	39	13	38
SLOPE			
0- 9	70	49	84
10- 25	27	26	13
26- 50	3	25	3
over 50	0	0	0
DISTANCE TO COVER			
0- 10 m	47	64	28
10- 50	13	18	16
50-100	29	16	7
100-200	2	0	7
over 200	9	2	42
TOPOGRAPHY			
Ridge	1	1	3
Upper Slope	10	4	0
Mid Slope	10	38	35
Low Slope	21	23	5
Bench	56	26	44
Creek	3	9	13

ELEVATION	ELK (120)	DEER (1013)	MOOSE (61)
610- 760 m	64	41	59
761- 910	10	35	20
911-1060	5	19	18
1061-1220	0	2	2
1221-1370	3	3	0
1371-1520	0	1	0
1521-1680	8	1	0
1681-1830	10	0	0
1831-1980	0	0	0
HABITAT TYPE			
THPL Series	4	8	5
TSHE Series	77	78	91
ABLA Series	18	1	2
PSME Series	1	14	2
DISTANCE FROM ROAD			
0- 10 m	18	19	10
10- 50	0	2	0
50-100	0	1	2
100-200	0	1	3
over 200	82	78	85
CONFIGURATION			
Convex	0	2	5
Straight	32	37	23
Concave	6	8	13
Undulating	62	53	59

[1] Ungulate sign which could not be identified to species is included with deer data.

[2] Total number of sign observed during fall and winter. Sign includes tracks, pellet groups and beds.

STATEMENT OF WORK

Division 100 - GENERAL REQUIREMENTS

110 - Scope of Contract Provide services to complete a grizzly bear habitat study of two areas comprising 6,700 and 43,800 acres in accordance with the attached terms and specifications.

120 - Location The intensive survey area, 6700 acres, and the extensive survey area, 43,800 acres, are located within the Troy and Cabinet Ranger Districts of the Kootenai National Forest and the Sandpoint Ranger District of the Idaho Panhandle National Forest. Both areas are shown on the attached map, Appendix A.

130 - Introduction

The Forest Service recognizes the Cabinet Mountains as occupied grizzly bear (Ursus arctos horribilis) habitat. In response to the classification of the grizzly bear as "threatened" under the provisions of the Endangered Species Act of 1973, the Forest Service recommended to the U.S. Fish and Wildlife Service that certain areas be classified as "critical habitat." Four such areas were recommended on the Kootenai National Forest. These are:

1. Whitefish Range Tract
2. Vermilion Tract
3. Cabinet Mtn. Tract
4. Scotchman Peak Tract

The U.S. Fish and Wildlife Service subsequently proposed all these areas, plus substantially more acreage be classified as "critical habitat" to the grizzly bear. During the Forest Service inventory and analysis of the Bull Lake Planning Unit, grizzly bear habitat was identified on the basis of extensive field review, analysis of habitat types, and aerial photos. The identified habitat in the Bull Lake Planning Unit contains a significant portion of the planning unit above five thousand feet elevation, and some select features below this elevation.

The American Smelting and Refining Company has plans to construct a mine on Mt. Vernon, which is located within the Bull Lake Planning Unit. The milling facilities, roads and a slurry pipeline are to be located in Stanley Creek, a drainage flowing north from Mt. Vernon.

All of the proposed mine facilities are located within the U.S. Fish and Wildlife's proposed critical habitat for the grizzly bear.

Statement of Work, continued

Certain facilities will be located within the area proposed as "critical habitat" by the U.S. Forest Service in accordance with the "Criteria for Grizzly Bear Critical Habitat Identification" 1/. During the inventory stage for the Bull Lake Planning Unit, the Forest Service identified grizzly bear habitat using a combination of habitat types with known importance to grizzlies 2/ 3/ and the previously mentioned criteria developed in Region One.

140 - Government-furnished Services and Property

141 - Services The following will be provided:

.1 - Incidental field assistance of the Kootenai Wildlife Biologist and related transportation. The time for such assistance will be mutually agreed upon, but shall generally be limited to assistance related to project introduction and task review.

.2 - Existing information pertaining to grizzly bear habitat in the study area.

.3 - Services by Forest personnel to type rough and final draft of the final report.

.4 - Photocopy services

.5 - Forest Service maps of study areas.

142 - Property

.1 - Loan of available aerial photos of study areas.

.2 - Paper, bond, size 8" x 10½", and binders for the final report.

.3 - One copy of "Method for Determining Grizzly Bear Habitat Quality and Estimating Consequences of Impacts on Grizzly Habitat Quality" by Stephen P. Mealey.

1/ U.S.F.S. 1975. Criteria for Grizzly Bear Critical Habitat Identification. U.S.F.S., Region One. 18 pp.

2/ Mealey, S.P., Jonkel, and Demarchi. 1977. Habitat Criteria for Grizzly Bear Management. Presented at the 13th American-International Conference of Game Biologists. Atlanta, GA. 13 pp.

3/ Jonkel, Chas. 1976. Border Grizzly Project Annual Report. College of Forestry, University of Montana. 111 pp.

150 - Contractor Furnished Items and Review Schedule

.1 - The Contractor will provide all necessary transportation, services, per diem, incidentals, except as noted above, and the management needed to meet the objectives and specifications of the study described herein.

.2 - The Contractor shall submit an interim report of all data collected based on the following schedule:

(a) July 1, (b) September 1, (c) Last week of field work

.3 - Prior to submission of the final report a rough draft copy shall be furnished to the Contracting Officer for review and comment.

160 - Rights in Data

161 - The term "Subject Data" as used herein includes writings, pictorial reproductions, drawings, or other graphical representations, and works of any similar nature produced for this contract.

162 - All "Subject Data" produced specifically for this contract is the sole property of the Government and may not be used by the Contractor without written permission from the Government.

163 - It is hereby agreed that the Government has complete rights to publish, translate, reproduce, deliver, perform or use in any manner all "Subject Data" produced specifically for this contract.

Division 200 - TECHNICAL REQUIREMENTS

210 - Task I

Provide information relative to the quantity and quality of grizzly bear habitat in both the Intensive and Extensive Study Areas.

INTENSIVE AREA

Within the Intensive Study Area the Contractor shall map habitat types, as prescribed by Pfister, Robert et. al.: 1974, in the Forest Habitat Types of Montana, down to the phase and subdivide into major successional stages. Accuracy shall be at least to the 90% level. All non-forested grizzly habitat components, as described by Mealey, Jonkel, and Demarchi 1977, Habitat Criteria for Grizzly Bear Management, shall be mapped to at least the 95% accuracy level. Accuracy levels will be verified by randomly located check plots taken by the Government.

Within the Intensive Survey Area the Contractor shall measure grizzly food abundance at least three times, once during each of the following periods:

(a) May 1 - May 15
(b) June - early September
(c) Mid September to end of October

The method used to measure grizzly bear food abundance and habitat quality will be that developed by Stephen P. Mealey in "Method for Determining Grizzly Bear Habitat Quality and Estimating Consequences of Impacts on Grizzly Habitat Quality." (USDA Forest Service, Northern Region Contract No. 11-1200, February 1977.) Five or more 1/10th acre plots shall be measured seasonally in each habitat type phase and major successional stages present in the study area.

A minimum of five 1/10th acre plots shall also be measured within each major successional stage of each present non-forested grizzly bear habitat component as described by Mealey, et. al. 1977.

EXTENSIVE AREA

Within the Extensive Survey Area existing habitat type maps shall be refined and non-forested grizzly habitat components mapped. Emphasis within the Extensive Survey Area shall be placed on mapping the following habitat types down to phase:

(a) AF/WBP (Pinus Abies/Albicaulis lasiocarpa)
(b) AF/Xete (Abies lasiocarpa/Xerophyllum tenax)
(c) AF/Luhi (Abies lasiocarpa/Luzula hitchcockii)
(d) AF/Clun (Abies lasiocarpa/Clintonia uniflora)
(e) AF/Vasc (Abies lasiocarpa/Vaccinium scoparium)
(f) AF/Vagl (Abies lasiocarpa/Vaccinium globulare)
(g) AF/Caca (Abies lasiocarpa/Calamagrostis canadensis)
(h) S/Clun (Picea/Clintonia uniflora)
(i) DF/Xete (Pseudotsuga menziesii/Xerophyllum tenax)
(j) DF/Vagl (Pseudotsuga menziesii/Vaccinium globulare)
(k) DF/Libo (Pseudotsuga menziesii/Linnaea borealis)
(l) DF/Caru (Pseudotsuga menziesii/Calamagrostis rubescens)

In addition, the following non-forested habitat components shall be mapped:

(a) meadows
(b) avalanche chutes
(c) sidehill parks

(d) burns
(e) stream bottoms
(f) ridgetops
(g) talus slopes

The Government estimates total field time to accomplish Task I will be approximately 60 days.

220 - Task II

The Contractor shall gather data relative to the use by grizzly bear of the Intensive and Extensive Survey Areas. An intensive reconnaissance of these areas shall be made to locate grizzly bear sign including, but not limited to:

(a) direct observations
(b) tracks
(c) scats
(d) diggings
(e) clawed trees
(f) ripped stumps
(g) overturned rocks
(h) dens

Only sign believed to be from grizzly bear shall be recorded. When a sign is found the Contractor shall:

1. Record sign location as to its relationship to forested or non-forested habitat components.

2. Record the exact location by Township, Range, Section, and geographic description.

3. Estimate and record the probable time of year when made.

4. If a scat, collect it for analysis by the Wildlife Laboratory, Montana Department of Fish and Game, Bozeman. All samples shall be given to the Government.

5. Photograph the sign for use in the final report.

The Contractor shall collect grizzly bear sign data throughout the field season, but not less than two times per season (spring, summer, fall). The first collection shall be made in early May.

Total field time shall not be less than 60 days to accomplish Task II.

Statement of Work, continued

230 - Task III

The Contractor shall prepare a final report, which will include:

1. An accurate habitat type map based on the field work performed in Task I.

2. An accurate map showing the location of non-forested grizzly bear habitat components based on information performed in Task I.

3. Qualitative and quantitative data gathered in the Intensive and Extensive Survey Areas including a summary of the data by habitat type and phase, and non-forested habitat components as performed in Task I.

4. A map with written and photo documentation of all grizzly bear sign or observations made during the execution of Task II.

5. A professional appraisal as to the value of the Intensive and Extensive Survey Areas to grizzly bear, including areas suspected to be valuable as seasonal or year-round habitat. The Contractor shall make reference to specific sites, habitat types, or non-forested components and reference scientific research if it is necessary to extrapolate or elaborate beyond the data collected in Task I or Task II.

Division 300 - INSPECTION

310 - The Government will review collected data as scheduled in Division 150 and make field inspections as desired.

Division 400 - PAYMENT

410 - Upon request and receipt of billing from the Contractor payments may be made as follows:

After review of interim report	
July 1 -	20 percent
September 1 -	20 percent
Last Week Field Work -	20 percent
After review of Rough Draft -	10 percent
Final Acceptance -	30 percent

Grizzly Bear Study Habitat Components

010 Scree. This is a relatively minor type in the study area. For the purposes of this study, the treeless and/or rough broken terrain portions of this type as defined by Pfister *et. al*., (1977) were assigned a separate category, rock and cliffs (see below). As used in this report, scree can be defined as an open, relatively continuous slope covered with loose rock fragments, supporting a sparse undergrowth and an open tree cover. It is possible this type could produce significant amounts of bear food, particularly succulent herb tops, in the spring season.

020 Rock and cliffs. Extremely steep, cliffy, terrain, that supports a variable plant cover, talus slopes, and the steep, bare, slab rock typical of the higher elevations along the Ross Creek divide, are included in this type. This habitat component is widespread in the study area. It is doubtful that much bear food is produced in this type except where it contains microsites of other habitat components. For example, the relatively flat north-facing slopes in Sections 1 and 6 west of Little Spar Lake, are mapped as rock (020). When viewed on the CIR photos (flight line 24S, numbers 9-200 and 9-201) this area is obviously predominantly slab rock, with a mosaic of rock and pockets of Abla/Luhi-Mefe (832). The northwest slopes of Spar Peak support a fair tree cover and undoubtedly produce significant amounts of bear food, such as huckleberries.

030 *Alnus* scrub. The most common non-forested habitat in the study area. Although this type contains most of the species found in Mealey's description of "avalanche chutes" it is not restricted to actual slide paths in the study area, probably due to the high annual precipitation in extreme northwestern Montana. Within the study area, this type is similar to the *Alnus sinuata* scrub described by Daubenmire (1968) for northern Idaho and eastern Washington. As defined by Daubenmire, this type occurs in "seepage areas in shallow but steeply sloping ravines", and "supports a climax deciduous scrub about 4 m. tall in which *Alnus* is dominant." In the Abla/Mefe and Abla/Clun-Mefe habitat types, this *Alnus* dominated scrub appears to rapidly invade burned and logged areas where it forms an apparently long-lived seral condition. The most important bear food species present are: Poaceae (Graminae), *Carex* spp., *Claytonia lanceolata*, *Angelica dawsonii*, *Osmorhiza occidentalis*, *Ligusticum* spp., Polypodiaceae, *Veratrum viride*, *Montia* spp., *Sorbus scopulina*, *Lonicera utahensis*, and *Sambucus racemosa*. Seven food abundance plots were established in this type. The Food Habitat Quality Rating (FHQR), (Mealey, 1977) is high with a score of eleven (H/11) for spring bear use, high with a score of ten (H/10) for summer bear use, and medium with a score of eight (M/8) for fall

use. Importance value (IV is 23.3 for spring and 14.3 for summer and fall.)

031 *Vaccinium* scrub. This is the major successional stage within the Abla/Xete-Vagl H.T. The vegetation is dominated by *Xerophyllum tenax* and *Vaccinium globulare* and is essentially the same as climax Abla/Xete-Vagl understory. Food abundance plots are discussed under the Abla/Xete-Vagl H.T.

032 Shrubfield-seedling stage (Abla/Clun-Mefe, H.T.). This type was found in a clearcut at the head of Weasel Gulch. It has a form complement similar to that of the *Alnus* scrub but lacked the heavy shrub cover. *Menziesia ferruginea*, *Sambucus racemosa*, *Lonicera utahensis*, *Vaccinium globulare* and *Rosa* spp. were the dominant shrubs. Succulent herb tops are the most important bear food group in this habitat, with the Poaceae and *Carex* spp. the most important plants. Five food abundance plots were established in this type. FHQR is H/10 for spring, M/8 for summer, and M/7 for fall. IV is 6.0 for spring and 7.0 for summer and fall.

040 Sidehill parks are found on south and west slopes. Succulent herb tops are the dominant bear food species present. *Agropyron spicatum* is dominant at lower elevations while *Festuca viridula*, and *Melica spectabilis* become important dominants at higher elevations. The FHQR is H/11 for spring, H/9 for summer, and M/8 for fall. IV is 21.2 for spring and 11.7 for summer and fall.

050 Wet meadows. Although this type occurs rarely in the study area, it undoubtedly produces significant amounts of succulent herb tops throughout spring, summer and fall. This type occurs in poorly drained canyon floors or as morainal ponds. The vegetation is characteristically a fen type dominated by *Carex* spp. and the Poaceae.

060 Low elevation logged areas. This type occurs in the northeast portion of the study area on Lower Stanley Creek and north of Bull Lake. Several types of logging are represented, from very recent to those several years old. Early successional stages are dominated by several deciduous shrubs as well as conifer seedlings. Important shrubs are *Ceanothus sanguineus*, *Salix* spp., and *Vaccinium globulare*.

261 *Pseudotsuga menziesii*/*Physocarpus malvaceus*-*Physocarpus malvaceus* Habitat Type (Psme/Phma-Phma). This habitat type is found primarily on the steep south to west slopes such as the lower elevations above Ross Creek. The Poaceae is the most important plant group with *Agropyron spicatum* being the dominant species. *Amelanchier alnifolia*,

Lonicera utahensis, *Prunus virginiana* and/or *Prunus emarginata* are also important in this type. All of these species occur primarily in openings in the forest canopy. Under a tree canopy, *Holodiscus discolor* and *Calamagrostis rubescens* assume understory dominance. Only summer and fall evaluations were conducted for the five plots established in this type. However, such spring ephemerals as *Collinsia parviflora* and *Collomia linearis* were evident, consequently, a spring reading would yield no additional data. FHQR and IV are M/8 and 8.0 respectively for summer and M/7 and 8.0 for fall.

283 *Pseudotsuga menziesii*/*Vaccinium globulare*-*Xerophyllus tenax* Habitat Type (Psme/Vagl-Xete H.T.). This is a minor type in the study area, being found on steep west slopes in the West Fork of Blue Creek. This area was mapped as Psme/Xete by the Kaniksu National Forest following Pfister (1972). This habitat type was recently changed to the Xete phase of the Psme/Vagl Habitat Type (Pfister *et*. *al*., 1977) and is mapped as such for this study.

521 *Abies grandis*/*Clintonia uniflora*-*Clintonia uniflora* Habitat Type (Abgr/Clun-Clun H.T.). This is a minor habitat type in the area and of relatively minor importance as a producer of bear food. Five food abundance plots were established in this type. The succulent herb tops were the most abundant food crop with a subtotal coverage of 22.4. FHQR and IV are M/7 and 2.7 for summer, and M/6 and 2.7 for fall.

550 *Thuja plicata*/*Oplopanax horridum* Habitat Type (Thpl/Opho H.T.). This type occurs on saturated soils at lower elevations in Stanley and Ross Creeks. The importance of this type as a bear food producer is probably quite low although several species of the Polypodiaceae are common.

571 *Tsuga heterophylla*/*Clintonia uniflora*-*Clintonia uniflora* Habitat Type (Tshe/Clun-Clun H.T.). This is probably the least important habitat type in the study area in terms of bear food production. It is also the most widespread habitat type at elevations below approximately 4,700 feet. FHQR and IV for spring, summer and fall are M/5, 1.4; M/7, 1.4; and M/8, 24.

610 *Abies lasiocarpa*/*Oplopanax horridum* Habitat Type (Abla/Opho H.T.). A minor type in the study area found on Spar Creek. It is the same as the Thpl/Opho H.T. except it occurs above the cold limits of *Thuja* and *Tsuga heterophylla*. The value of the Abla/Opho H.T. to bears would be chiefly in supplying cover. Preferred food production is quite low.

621 Abies lasiocarpa/Clintonia uniflora-Clintonia uniflora Habitat Type (Abla/Clun-Clun H.T.). This habitat type most commonly occurs as a relatively narrow band between Abla/Xete-Vagl above and Tshe/Clun-Clun below. It is low in bear food productivity with fruit bearing shrubs the most abundant food group. Five food abundance plots were established in this type. FHQR and IV for spring, summer, and fall are M/7, 2.4; H/9, 2.4; and M/8, 2.4 respectively.

625 Abies lasiocarpa/Clintonia uniflora-Menziesia ferruginea Habitat Type (Abla/Clun-Mefe H.T.). This type occurs commonly throughout the study area, usually on north and east slopes. It forms a narrow band between Abla/Mefe above and Tshe/Clun-Clun below. The main value of Abla/Clun-Mefe as a food producer occurs in early successional stages as discussed under the shrubfield-seedling stage (032). In climax condition, because of dense canopy, food production is quite low as is that of the adjoining habitat types.

650 Abies lasiocarpa/Calamagrostis canadensis Habitat Type (Abla/Caca H.T.). This type occurs in low gradient stream bottoms at the heads of drainages. Although this type is rarely encountered in the study area, it has a high importance as a bear food producer. Due to the high water table, succulent herb tops, primarily the Poaceae, Cyperaceae, and Apiaceae, (Umbelliferae) remain green and succulent throughout the summer season. This increases the importance of this type as a bear food producer.

670 Abies lasiocarpa/Menziesia ferruginea Habitat Type (Abla/Mefe H.T.). This is a widespread habitat type usually found on north and east slopes at upper elevations in the study area. Under a sparse canopy Vaccinium globulare becomes the important bear food species. Spring, summer and fall FHQR and IV are M/6 and 3.0; M/8 and 3.0; M/7 and 3.0 respectively.

691 Abies lasiocarpa/Xerophyllum tenax-Vaccinium globulare Habitat Type (Abla/Xete-Vagl H.T.). This habitat type is widespread in the study area on southerly slopes above approximately 5,200 feet. Vaccinium globulare is the most important food plant. For the five food abundance plots in this type, the FHQR is M/7 for spring and H/9 for summer, and M/8 for fall. IV is 8.6 for all seasons.

710 Tsuga mertensiana/Xerophyllum tenax Habitat Type (Tsme/Xete H.T.). A minor type in the study area, Tsme/Xete is the same as Abla/Xete-Vagl (691, above) with the addition of Tsuga mertensiana as a climax codominant with Abies lasiocarpa.

831 Abies lasiocarpa/Luzula hitchcockii-Vaccinium scoparium Habitat Type (Abla/Luhi-Vasc H.T.). This type primarily occupies the south to west exposures above 6,000 feet. Together with the Tsme/Luhi-Vasc variant, Abla/Luhi-Vasc represents the warmest and driest of the subalpine habitat types in the study area. These types, together with the Abla/Luhi-Mefe Habitat Types, are frequently encountered as microsite situations in the extensive area mapped as rock and cliffs along the main Ross Creek divide. These microsites contribute significantly to the value of the rock and cliff habitat component as a bear food producer. The combination of both succulent herb tops and starchy herb roots give the Abla/Luhi-Vasc H.T. a high value as a bear food producer. Both food groups are often locally abundant throughout the subalpine region.

832 Abies lasiocarpa/Luzula hitchcockii-Menziesia ferruginea Habitat Type (Abla/Luhi-Mefe H.T.). This subalpine type occurs primarily on north and east exposures above 6,000 feet. As with the Abla/Luhi-Vasc type, succulent herb tops and starchy herb roots are often locally abundant and make this type an important bear food producer.

841 Tsuga mertensiana/Luzula hitchcockii-Vaccinium scoparium Habitat Type (Tsme/Luhi-Vasc H.T.). This type is identical to the Abla/Luhi-Vasc H.T. with the addition of Tsuga mertensiana as a climax codominant.

APPENDIX P

Planning Regulations

City and County Planning Enabling Act (Title 11, Chapter 38, Sections 3801 through 3858) 1957

This law authorizes local governments to conduct community planning programs and sets out the procedures for the formation and operation of local planning boards. A planning board serves only in an advisory capacity to the local governing body or bodies. It is authorized to propose policies for subdivision plats, land uses, public facilities and community development.

The chapter requires the planning board to prepare a "master plan" (more often called a "comprehensive plan"). The law includes a list of subjects which the plan may address but does not establish any minimum requirements for the content of the plan nor does it establish a deadline for completion of the plan by the planning board. The master plan does not, of itself, have any regulatory function. After the plan has been adopted, the local governing body is required to give consideration to the general policy facilities and adoption of subdivision regulations or zoning ordinances. However, the statute does permit the local governing body to "require subdivision plats to conform to the provisions of the master plan". In such cases the planning board must review subdivision plats and advise the governing body of their compliance or noncompliance with the master plan. The law also requires that all local governments which have an adopted plan and subdivision regulations must seek the advice of the planning board on all subdivision proposals.

The law prohibits the adoption of any regulation "which would prevent the complete use, development, or recovery of any mineral, forest, or agricultural resources by the owner thereof".

Subdivision and Platting Act (Sections 11-3859 through 11-3876) 1973 A

This act specifies that mobile home and recreational vehicle parks, condominiums and divisions of land for sale, rent or lease into parcels of less than 20 acres are "subdivisions" and must be approved by the local governing body. A deed or other conveyance of interest in a parcel may not be recorded unless it refers to a subdivision plat that has been filed in the county clerk and recorder's office, and a subdivision plat may not be filed until it has been approved by the governing body. The law does provide that in certain situations divisions of land into parcels less than 20 acres are exempt from the approval requirement. Mobile home and recreational vehicle parks, condominiums and subdivision lots for lease must be approved by the governing body before lots or parcels may be rented or leased or any interest in property conveyed.

Every subdivision must provide for parks or playgrounds one-ninth of the total area of all lots up to five acres in size and one-twelfth of the total area of all lots from five to 10 acres. The requirement may be met by dedicating land to the public, reserving privately-owned land or donating cash in lieu of land. The cash must go into a park fund and be used for acquisition or initial development of parks or playgrounds.

Each county and incorporated city or town must adopt and enforce a set of local subdivision regulations which specify procedures and design standards by which a proposed subdivision is reviewed and approved. This act directs the Department of Community Affairs to promulgate minimum requirements to be contained in local regulations. Those minimum requirements, adopted by the Department as administrative rules, specify that local regulations must contain standards for minimum road widths, maximum road grades, grading and surface drainage, lot configuration, traffic circulation and park areas. The administrative rules also require local regulations to provide for disapproval of a proposed subdivision if it is on a floodplain, in an area of high groundwater, or steep slopes, or in any other area subject to natural or man-made hazards.

As part of the procedure for obtaining approval of subdivisions containing more than five lots, a subdivider must submit a preliminary plat and an environmental assessment which describes the effects the proposed subdivision would have on the physical environment and on community services and facilities.

In order to approve the subdivision, the governing body must find that the subdivision would be in the public interest. The criteria which must be weighed in reaching that decision are (a) the basis of the need for the subdivision, (b) expressed public opinion and (c) the subdivision's effects on agriculture, local services, taxation, the natural environment, wildlife and public health and safety.

County Zoning (Title 16, Chapter 47) 1963

Under this statute county commissioners are permitted to adopt zoning regulations after a master plan has been adopted for an area. The regulations may control residential, commercial and industrial uses, but agriculture, forestry and mining activities are specifically exempt from regulation.

The county commissioners must require the planning board to make recommendations concerning boundaries of the various use districts, to propose appropriate regulations, and to publish notice and hold a public hearing on the proposals. If, during the 30-day protest period which follows the hearing, more than 40 percent of a zoning district's voters oppose in writing the governing body's resolution to adopt zoning, the resolution cannot be adopted.

If a county is conducting, or intends to conduct, studies for a master plan or zoning regulation, the Board of County Commissioners may adopt as an emergency measure an interim zoning regulation. The interim resolution is limited to one year, with an additional year's extension allowed. The procedural requirements outlined also apply to interim zoning.

Building and Mobile Home Construction Standards (Title 69, Chapter 21) 1969 A

This chapter authorizes local governments to adopt minimum standards relating to the design, construction, alteration and repair of buildings, The Department of Administration is directed to adopt, by reference, nationally recognized building codes, in whole or in part, or rules more stringent that the national codes. These adopted codes and rules constitute the State Building Code. A municipal or county building code may include only codes adopted by the Department. A local government cannot enforce a building code until the local code and a plan of enforcement have been filed with the Department and certified by it. The Department may authorize municipalities to extend their building codes up to 4½ miles beyond their city limits and to any subdivision or area which has been zoned and part of which is within 4½ miles of the city.

Where a county or municipality has not adopted a building code, the State Building Code is in force for all public buildings, such as schools or places "where the public has a right to go and be", such as apartment and commercial buildings.

The Department also adopts standards for recreational vehicles, approves plans for construction of factory-built modular homes and recreational vehicles , and provides periodic inspection of in-state manufacturers to assure that plan specifications are followed. Modular homes and recreational vehicles originating from out-of-state are exempted from inspection when the state of origin enforces a similar inspection program.

Standards for mobile homes have been adopted by the federal government and inspection is conducted by federal authorities.

County Water and Sewer District Act (Title 69, Chapter 45) 1957

This act authorizes the formation of a county water and/or sewer district in any sub-county, countywide or multi-county area. Registered voters within the proposed district, and within each included county, petition the county commissioners to create the district. After public notice and public hearing or hearings, electors residing in the district must approve the formation of the district, which becomes an incorporated entity. The District Board of Directors consists of five persons elected within the district, plus one appointed by the mayor of each included municipality and one appointed by the Board of County Commissioners of each included county having unincorporated territory in the district.

A county water and sewer district (a) may acquire water rights and (b) may acquire, construct, maintain and operate water works, sanitary or storm sewer works, canals, conduits, reservoirs and lands and rights useful or necessary to store, conserve, supply, produce, convey or drain water or sewage for purposes useful to the district. Useful purposes include, but are not limited to flood prevention, flood control, irrigation, drainage, municipal and industrial water supply, domestic water supply, wildlife, recreation, pollution abatement, livestock water supply and similar purposes. Districts may store water, lease waterworks, accept assistance, borrow money and issue bonds, set fees and levy taxes and make contracts.

Sanitation in Subdivision Act (Title 69, Chapter 50) 1967 A

This act prohibits the filing of a subdivision plat with a county clerk and recorder, the sale of any lot within a subdivision or the construction of any building or water or sewage system in a subdivision until the Department has approved the provisions for water supply and disposal of wewage and solid waste. The law applies to divisions of land for sale, rent or leas e which create parcels, parks and condominiums. The definition of "subdivision" under this act approximates that in the Subdivision and Platting Act.* Certain divisions of land, such as occasional sales and family conveyances, which are exempt from review and approval under the Subdivision and Platting Act are not exempt from DHES review.

Within areas covered by an adopted master (comprehensive) plan, a final plat may be filed without Department approval of sanitary facilities if the governing body certifies that municipal water supply and sewage disposal facilities must be reviewed by the Department prior to construction of the systems, under the provisions of the Public Water Supply Law. Where land is acquired to add to an approved parcel, Departmental approval is not required if no dwelling or building requiring water and sewer facilities will be built on the additional land.

The Department must delegate to local units of government the authority to review the sanitary facilities for subdivisions with five or fewer lots where the local government has qualified personnel to conduct the review.

The Department has adopted administrative rules which establish procedures for the submittal, review and approval of subdivisions and has specified standards for their sanitary facilities. Before approving or disapproving the sanitary facilities for larger subdivisions, the Department must prepare an environmental impact statement in accordance with the Montana Environmental Policy Act. If a written complaint of a violation is sent to the Department, the law requires the Department either to hold a hearing or to take injunctive action against the party in violation.

Floodway Management and Regulation (Title 89, Chapter 35) 1971

The Board of Natural Resources and Conservation has the author to delineate both the 100-year frequency floodway (the channel carrying the largest volume and highest velocity floodwater) and the 100-year frequency floodplain (the total area inundated by water) of every water course in the state and to restrict the uses permitted within the floodplains. Once the Board of Natural Resources and conservation has designated a floodplain, the local governing bodies have six months to adopt land use regulations if the local government does not adopt its own. All non-conforming uses or structures proposed for delineated floodplain areas must receive a permit from the local governing body, or from the department if the local unit fails to act.

If locally adopted land use regulations for the designated area meet board standards, the local governing body may administer the permit system to allow certain activities within the floodplain. Existing or open space uses are allowed without permits in the floodplain area.

APPENDIX Q

Quality of Life Surveys for Troy Montana

I.

SAMPLING SURVEY AND INTERVIEW PROCEDURES AND RESULTS

During the week of June 13, 1977, three staff members from T.A.P., Inc. were in Troy, Montana. The purpose of this trip was to gather baseline information and conduct surveys and interviews with people in the area to determine variables important to the local people on quality of life.

Initial investigations upon arriving in the area revealed that two previous surveys dealing in part with quality of life elements had been recently completed in the spring of 1976. Some research was done by Linda L. Sootsman for the Kootenai National Forest and Lincoln County Planning Board. The results of this work are written up under the title "The Opinions of the Citizens of Lincoln County as they Relate to the Management of the Kootenai National Forest and the Functioning of Lincoln County Government", the date on the publication is June 4, 1976. In addition to this study, a student at the University of Montana in Missoula conducted an independent survey in November of 1976 which dealt in part with elements pertaining to the quality of life in the Troy area. The author was Kathy Nielsen and the title of her research results is "A Survey of Community Attitudes Among the Citizens of Troy, Montana Concerning a Copper-Silver Mine Proposed for that Region". The date on her paper is December 10, 1976. Pertinent results from each of these surveys will be presented later in this section.

The parameters of the research work for the T.A.P. survey in June of 1977 were pre-selected and approved and consisted of the following points:

1. The setting of the Troy area
2. The perceived quality of water in the Troy area
3. Noise levels
4. Local attitudinal atmosphere
5. Background of Troy inhabitants

6. Personal value systems
7. Isolation
8. Mobility of residents
9. Occupation or daily endeavor
10. Local buying habits
11. Area economic opportunities
12. Condition and location variables relating to dwelling units
13. Adequacy of public services including educational facilities, safety, welfare, medical and retirement
14. Level of organizational influence
15. Area recreational opportunity
16. Communications

Prior to arrival in Troy, the questionnaire was devised attempting to develop information around the quality of life elements listed.

Exhibit 1, included here, is entitled "Proposed ASARCO Mine Environmental Impact Statement Quality of Life Survey, Troy, Montana". This interview or survey form lists 35 questions which form the basis for the determination of the existing quality of life of the Troy area. This survey was made through personal interviews of randomly selected households within the city limits of Troy as well as along highway #202, the Lake Creek area, the Iron Creek area and the residential concentration known as Kootenai Vista.

The total number of household or dwelling units in this area was estimated at 480 by the local power utility company. Seventy-nine of these households were surveyed for a sample size of 16 1/2 percent of all households. In the 1970 census, the Troy area had an average of 2.62 people per household. By applying that 2.62 average to the 480 households estimated for the area, the total people represented in our sample would be 4,258. We personally interviewed 79 individuals for a 6.3 percent sample size based on total population. The households were selected in a random fashion by using a random number technique. The procedure involved surveying every fourth household visible from a street or road. It was a requirement that the respondent at each of the selected households be an adult. In addition to the 79 individuals surveyed, 15 organizational representatives were interviewed using the same basic questionnaire guide. These results are separately tabulated. Interviews were conducted both during the day and evening, so that working individuals would not be excluded. The sampling procedure was uniformly applied throughout the entire interview process.

Exhibit 1 follows with the listed questions and the raw responses directly beneath.

EXHIBIT 1

PROPOSED ASARCO MINE ENVIRONMENTAL IMPACT STATEMENT
QUALITY OF LIFE SURVEY
Troy, Montana

Interviewer________________

Name__________________________________ Date_______________________

1. Are you employed?

Yes	52 (68%)
No	10 (13%)
Retired	15 (19%)
	77 (100%)
No Response	2

2. If yes, what is your occupation?

Housewife	26 (50%)
Logging or lumber industry	10 (19%)
Laborers	2 (4%)
Forest Service	2 (4%)
Self-Employed	2 (4%)
Part-Time Workers	4 (8%)
Other occupations of which there was no significant number in each category	6 (11%)
	52 (100%)

3. How long have you lived in Troy?

Lifetime	11 (14%)
10 yrs. or less	33 (42%)
11-20 yrs.	5 (7%)
21-30 yrs.	19 (24%)
31-40 yrs.	3 (4%)
41-50 yrs.	2 (3%)
51-60 yrs.	2 (3%)
61-70 yrs.	1 (1%)
3 of last 10 yrs.	1 (1%)
Summers only here	1 (1%)
	78 (100%)
No Response	1

4. Where are you originally from?

Out-of-State	41 (60%)
Other Montana City	24 (36%)
Originally from Troy, then moved back	3 (4%)
	68 (100%)

California	8 (12%)
Minnesota	7 (10%)
Washington	8 (12%)
Libby	4 (6%)

5. Where did you live before you moved to Troy?

Same	34 (50%)
Other	31 (46%)
From Troy moved away then back	3 (4%)
	68 (100%)

Out-of-State	39 (57%)
Other Montana city	26 (38%)
California	7 (10%)
Washington	14 (21%)
Libby	10 (15%)

6. Why did you move to Troy?

Liked the area	17 (25%)
Work opportunities	23 (33%)
Moved with family	10 (15%)
Married resident	6 (9%)
Relatives in Troy	6 (9%)
Good place to retire	2 (3%)
Other reasons of no significant number:	4 (6%)
	68 (100%)

-Bought home in Troy
-Better school than where came from
-Get away from city

7. How long do you intend to live in Troy?

Life or indefinitely	58 (73%)
5 to 10 years	3 (4%)
Not much longer	3 (4%)
As long as there is work	2 (3%)
One year or less	2 (3%)
Don't know	11 (13%)
	79 (100%)

8. Do you own or rent your home?

Own	58 (73%)
Rent	18 (23%)
Other	3 (4%)
	79 (100%)

9. Are you satisfied with your home location and condition as it is today?

Yes	65 (86%)
No	11 (14%)
	76 (100%)
No Response	3

10. If not, why not?

Needs repair	4 (44%)
Too small	2 (23%)
Rent to high	1 (11%)
Too many kids nearby	1 (11%)
Too many shops nearby	1 (11%)
	9 (100%)
No Response	2

11. In choosing a locality in which to live, what factors are most important to you?

Environment	23 (20%)
Job opportunity	14 (13%)
People and neighborhood	14 (13%)
Small town or population	12 (10%)
Quiet & solitude	10 (8%)
Clear air & water	11 (9%)
Recreation	6 (5%)
Country living	5 (4%)
Climate	5 (4%)
Conditions for raising family	4 (3%)
Schools	4 (3%)
Other reasons mentioned:	10 (8%)
	118 (100%)

Affordable housing,
economy and taxes,
close to services,
religious facilities,
sewage system, home,
"old timer stays put"
(The total adds up to 118 because several people gave more than one response.)

12. What do you like best about living in Troy?

Small town	25 (22%)
Environment	25 (22%)
The people	18 (16%)
Climate	10 (9%)
Recreation	8 (7%)
Quiet	5 (4%)
Clean air & water	4 (3.5%)
Privacy	4 (3.5%)
Nothing	3 (3%)
School System	2 (2%)
Good place to raise family	2 (2%)
House	2 (2%)
Others:	5 (4%)
	113 (100%)

Everyone same
financially, active
churches, sense of
freedom, work

13. What do you like least about living in Troy?

Nothing	20 (24%)
Few stores and services	11 (14%)
No doctor or hospital	8 (10%)
Not enough work	7 (9%)
Isolation	3 (4%)
Winters	3 (4%)
Not enough activities for kids	3 (4%)
Taxes	2 (2%)
Poor transportation service	2 (2%)
Not enough social activities	2 (2%)
Unfriendly people	2 (2%)
Schools	2 (2%)
Others of which there was one response each:	17 (21%)
	82 (100%)

police, phoney judicial circumstances, Californians, too many on welfare, teenagers, hippies, tourists, not enough housing, far from job location, everybody knows everybody, noise, dogs, weather, bars, downtown area bad looking, too many people, don't know many people

14. What effect, if any, do you think the ASARCO mining activity will have on the Troy area?

Positive Effects

Job opportunities	33 (31%)
Help economy	24 (22%)
Community growth: MD, hospital, business, services, schools	29 (27%)
Bring people in	8 (8%)
No positive effects	6 (6%)
More tax money	2 (2%)
Will help, don't know how	2 (2%)
Clean up the area	1 (1%)
Need the ore	1 (1%)
	106 (100%)
No Response	2

Negative Effects	
None	27 (34%)
Increased population	15 (18%)
Pollute or affect environment	8 (10%)
Undesirable type people	6 (8%)
Yes, but don't know what	4 (5%)
Won't employ residents	3 (4%)
Inadequate housing here	3 (4%)
Overload schools	2 (3%)
Higher taxes	2 (3%)
Affect recreation	2 (3%)
Others mentioned once:	6 (8%)
Crowd town, food and clothing prices will rise, traffic increase, more people than jobs, shipping problem, will change Troy	78 (100%)
No Response	4

15. How do you feel about outsiders moving into Troy?

Welcome them	43 (54%)
Don't mind too much	25 (32%)
Would prefer not to have them	10 (13%)
Don't know	1 (1%)
	79 (100%)

16. Would the increased opportunity for more jobs in the Troy area be important to you? ______Yes ______No

Yes	57 (72%)
No	22 (28%)
	79 (100%)

17. Why or why not? (Regarding Question #16)

Bring jobs for women & kids	5 (11%)
Be able to return from college and work there	2 (5%)
Would help the economy	5 (11%)
Widen employment base (more work in area)	18 (40%)
Take people off welfare	4 (9%)
Bring better wages	1 (2%)
May provide bank, doctors	1 (2%)
More shopping	1 (2%)
Work closer to home	1 (2%)
Not important to me, but is to others in town	4 (9%)
No, because retired	3 (7%)
	45 (100%)
No Response	34

18. Could you estimate what percentage of your total purchases are made outside of Troy?

0%	5 (6%)
1 - 10%	4 (5%)
11 - 20%	4 (5%)
21 - 30%	6 (8%)
31 - 40%	3 (4%)
41 - 50%	11 (14%)
51 - 60%	2 (3%)
61 - 70%	5 (6%)
71 - 80%	8 (10%)
81 - 90%	4 (5%)
91 - 100%	4 (5%)
Very Few	11 (14%)
Groceries in Troy, clothing elsewhere	3 (4%)
No Idea	3 (4%)
90% clothing	1 (1%)
100% business needs	1 (1%)
Groceries in Troy, else out	1 (1%)
Groceries in Troy, 80% of rest out	1 (1%)
25% groceries and all clothing	1 (1%)
	79 (100%)

19. Concerning the following public services, how adequate do you feel they are in the Troy area?

(a) Educational facilities and opportunities

Very adequate	15 (19%)
Adequate	31 (40%)
Inadequate	25 (32%)
No Idea	7 (9%)
	78 (100%)
No Response	1

(b) Safety (police, fire)

Very adequate		13 (17%)
Adequate		45 (57%)
Inadequate		7 (9%)
Mixed answers on Police, Fire		11 (14%)
(Police)		
Adequate	4	
Inadequate	7	
(Fire)		
Adequate	5	
Very Ade.	6	
Don't know		2 (3%)
		78 (100%)
No Response		1

(c) Welfare Assistance

Very adequate	2 (3%)
Adequate	17 (21%)
Inadequate	4 (5%)
Too adequate, need to screen better	14 (18%)
Services located in Libby	10 (13%)
Don't know	31 (40%)
	78 (100%)
No Response	1

(d) Health care services and facilities

Adequate	11 (14%)
Inadequate	66 (85%)
Don't know	1 (1%)
	78 (100%)
No Response	1

(e) Care for the retired and aged

Adequate	7 (9%)
Inadequate	59 (76%)
Don't know	15 (15%)
	78 (100%)
No Response	1

20. Would you be willing to pay increased property taxes to improve any of the above services?

Yes	34 (46%)
No	28 (37%)
Depends on increase and circumstances	5 (7%)
Don't own property	5 (7%)
Don't know	2 (3%)
	74 (100%)
No Response	5

21. Concerning local governmental decisions, would you say the local residents have

(a) A lot of opportunity to participate
(b) Little opportunity to participate

(a)	47 (59%)
(b)	23 (29%)
Average	2 (3%)
Don't know	7 (9%)
	79 (100%)

22. How often do you exercise this opportunity? (Regarding Question #21)

Always	2 (5%)
Most of the time	6 (14%)
Sometime	11 (26%)
Very Little	13 (31%)
Never	10 (24%)
	42 (100%)
No Response	7

23. In the decision-making of the local governmental body, do you feel your comments or suggestions are considered?

Always	4 (13%)
Most of the time	14 (47%)
Sometimes	6 (20%)
Very little	3 (10%)
Never	1 (3%)
Don't know	2 (7%)
	30 (100%)
No Response	19

24. Which do you feel are the most influential groups or organizations in the community?

Lions	25 (22%)
Takima	19 (16%)
Troy Business & Professional Men	8 (7%)
Masons	9 (8%)
Churches	7 (6%)
School Board	6 (5%)
Troy Women's Club	4 (4%)
Firemen	3 (3%)
Jaycee's	3 (3%)
Troy Business & Professional Women	2 (2%)
Moose Lodge	2 (2%)
Bull Lake Rod & Gun Club	2 (2%)
Eastern Star	2 (2%)
Ambulance	2 (2%)
St. Regis	2 (2%)
Don't know	6 (5%)
Mentioned once each:	11 (9%)
	113 (100%)

Landowners, city council
Veterans Administration,
VFW Auxilliary, Voluntary
Dispatch, Sr. Citizens,
Cabinet Mountain Resource,
Welfare Dept., Bars,
Businesses, Scouts

25. What recreational opportunities do you enjoy within the Troy area?

Fishing	56 (29%)
Hunting	35 (18%)
Swimming	19 (10%)
Camping	14 (7%)
Lakes	9 (5%)
Picknicking	7 (3.5%)
Bowling	6 (3%)
Hiking	5 (2.5%)
Boating	5 (2.5%)
Baseball	5 (2.5%)
None	5 (2.5%)
Horseback riding	3 (1.5%)
Dancing	2 (1%)
Boxing	2 (1%)
Waterskiing	2 (1%)
Snowmobiling	2 (1%)
Huckleberry picking	2 (1%)
Enjoying the scenery quiet & solitude	4 (2%)
Others mentioned:	12 (6%)
	195 (100%)

Walking, distance running, skating, horse shoes, golf, partying, gardening, cards, bingo, watching kids play ball, homemaking, "living"

26. Do you feel the recreational opportunities would be affected by the mine development?

Yes	28 (35%)
No	40 (51%)
Don't Know	11 (14%)
	79 (100%)

27. If so, how? (Regarding Question #26)

Positive	
Might get lakes cleaned up	1 (3 1/3%)
More things for kids to do	1 (3 1/3%)
Might get new pool or tennis court	1 (3 1/3%)
Negative	
More competition for hunting, fishing, outdoor recreation	24 (80%)
Ruin outdoor recreation on mine site	1 (3 1/3%)
Pollute creeks & lakes	1 (3 1/3%)
Small lake roads couldn't handle more traffic	1 (3 1/3%)
	30 (100%)

28. Do you think there is a problem of water pollution in Troy?

Yes	10 (13%)
No	65 (82%)
Don't know	4 (5%)
	79 (100%)

29. If yes, what? (Regarding Question #28)

Inadequate sewage surveillance	4 (58%)
Kootenai	1 (14%)
Yaak	1 (14%)
Garbage along creeks	1 (14%)
	7 (100%)
No Response	3

30. Do you think there is a problem of noise pollution in Troy?

Yes	10 (13%)
No	68 (86%)
Sometimes	1 (1%)
	79 (100%)

31. If yes, what? (Regarding Question #30)

Trains & trucks	5 (50%)
Sonic boom	2 (20%)
Hotrodders	3 (30%)
	10 (100%)

32. Would an increase in traffic or equipment noise be of much concern to you?

Yes	24 (31%)
No	53 (68%)
Depends on truck routes	1 (1%)
	78 (100%)
No Response	1

33. Would you say you are very well informed, adequately informed, or not well informed about what is going on in:

(a) Troy

Very well	26 (33%)
Adequate	30 (39%)
Not well	22 (28%)
	78 (100%)
No Response	1

(b) The state of Montana

Very well	9 (12%)
Adequately	35 (45%)
Not well	34 (43%)
	78 (100%)
No Response	1

(c) The nation and world

Very well	18 (23%)
Adequately	44 (57%)
Not well	15 (19%)
Who cares?	1 (1%)
	78 (100%)
No Response	1

34. Do you feel "isolated" living in Troy?

Yes	19 (24%)
No	60 (76%)
	79 (100%)

35. If yes, how do you feel about it? (Regarding Question #34)

Like	13 (69%)
Dislike	5 (25%)
Neutral	1 (5%)
	19 (100%)

EXHIBIT 2

Exhibit 2 lists the results of the questions asked of organizations and government offices in the Troy area and their responses. As mentioned earlier, during the week of June 13, 1977, representatives of organizations and government offices in the Troy area were also interviewed by T.A.P. personnel. The groups interviewed were those considered to be the most effective or influential in the community. This was determined through the interview process in Exhibit #1. The questions asked of these group representatives were basically the same as those asked of individuals. However, some questions were eliminated, and the format of the questions were changed in order to reflect group attitudes. Following is a list of the 15 group representatives interviewed.

Organization	Representative
Masonic Lodge	Bob Russell
Takima Club	Marty Brewer
Troy School Board of Trustees	June Burns
Troy Business and Professional Men	Bobby Coldwell
Troy Lions Club	William Buyske
Voluntary Ambulance Service	Ron Higgins
Voluntary Dispatch	Mrs. Carr
Voluntary Fire Department	Jim Winslow
Minister of Local Church	**********
School Superintendent	Ted Rawlins
Cabinet Resource Group	Bill Martin
Senior Citizens	Florence Nelson
Mayor	Tony Brown
County Commissioner	Ray Lindsey
Montana Employment Service (Libby)	Jerry Allen

1. In choosing a locality in which to live, what factors are most important to the people of Troy?

Environment	7 (30%)
Simple, quiet life	4 (17%)
Job opportunities	3 (13%)
Stores & Schools	3 (13%)
People	2 (9%)
Area's economy	2 (9%)
Recreation	2 (9%)
	23 (100%)

2. What do people like best about living in Troy?

Friendly people	7 (27%)
Environment	6 (23%)
Climate	4 (15%)
Outdoor recreation	3 (11%)
Pioneer spirit	2 (8%)
Small town	2 (8%)
Quiet, seclusion	2 (8%)
	26 (100%)

3. What do people like least about living in Troy?

Isolation from special & professional services	7 (44%)
Lack of work	2 (13%)
Lack of entertainment & social activities	2 (13%)
Welfare, poverty	1 (6%)
Lack of available housing to buy	1 (6%)
Town's lack of incentive to progress	1 (6%)
Unawareness of the old timers	1 (6%)
Nothing	1 (6%)
	16 (100%)

4. What effect, if any, will the ASARCO mining activity will have on the Troy area?

Positive Effects	
Boost economy	8 (42%)
Create more jobs	5 (26%)
Need another industry	2 (11%)
Improve schools	2 (11%)
Might bring medical facilities	1 (5%)
Use of tailings on highway	1 (5%)
	19 (100%)

Negative Effects	
More people	6 (33%)
Housing problem	4 (21%)
Law problem	2 (11%)
Effect on environment, water	2 (11%)
Undesireable type people	1 (6%)
Busier town	1 (6%)
Tax dollars to county, not Troy	1 (6%)
Competition in recreation	1 (6%)
	18 (100%)

5. Would the increased opportunity for more jobs in the Troy area be important?

Yes	14 (93%)
No	0
Don't know	1 (7%)
	15 (100%)

6. Why or why not? (Regarding Question #5)

Second industry needed	3 (30%)
Present poor economy	2 (20%)
If available to people of the community	1 (10%)
Get people off welfare	1 (10%)
If job is right for self	1 (10%)
Present decline in woods job	1 (10%)
ASARCO may not be the answer	1 (10%)
	10 (100%)
No Response	5

7. What percent of the total purchases made by the residents are made outside of Troy?

90%	1 (8%)
60 - 80%	3 (23%)
50 - 60%	2 (15%)
20 - 40%	3 (23%)
1%	1 (8%)
Groceries here, clothing out	2 (15%)
Little	1 (8%)
	13 (100%)
No Response	2

8. Concerning the following public services, how adequate are they in the Troy area?

(a) Educational facilities and opportunities

Very adequate	2 (14%)
Adequate	7 (50%)
Inadequate	5 (36%)
	14 (100%)
No Response	1

(b) Safety (police, fire)

Very adequate		2 (13%)
Adequate		6 (40%)
Police & fire		7 (47%)
(Police)		
Adequate	1	
Inadeq.	6	
(Fire)		
Very Ade.	3	
Adequate	4	
		15 (100%)

(c) Welfare assistance

Very adequate	1 (8%)
Adequate	5 (46%)
Too adequate	2 (15%)
In Libby	4 (31%)
	13 (100%)
No Response	2

(d) Health care services & facilities

Inadequate	15 (100%)

(e) Care for the retired and aged

Adequate	3 (21%)
Inadequate	12 (79%)
	15 (100%)

9. Would most residents be willing to pay increased property taxes to improve any of the above services?

Yes	6 (46%)
No	7 (54%)
	13 (100%)

10. Concerning local governmental decisions, do local residents have

(a) A lot of opportunity to participate	12 (80%)
(b) Little opportunity to participate	3 (20%)
	15 (100%)

11. Which are the most influential groups or organizations in the community?

Takima	12 (29%)
Troy Business & Professional Men	5 (12%)
Lions Club	4 (9%)
Masons	4 (9%)
Fire Department	3 (7%)
Churches	3 (7%)
Troy Women's Club	2 (7%)
Moose Lodge	2 (5%)
Others named: Ambulance, Dispatch, Troy Youth, Recreation Assoc., Troy Business & Professional Women, VFW, School Board, Cabinet Resource Group	7 (17%)
	42 (100%)

12. What recreational opportunities are available within the Troy area?

Fishing	11 (22%)
Hunting	9 (18%)
Hiking	5 (10%)
Swimming	4 (8%)
Camping	3 (6%)
Boating	3 (6%)
Skiing	2 (4%)
Softball	2 (4%)
Golf	2 (4%)
Others mentioned: Snowshoe, snowmobile, horseback riding, gardening, observing nature, cards, bingo, pot lucks, youth recreation program	9 (18%)
	50 (100%)

13. Would recreational opportunities be affected by the mine development?

Yes	6 (40%)
No	8 (53%)
Don't know	1 (7%)
	15 (100%)

14. How? (Regarding Question #13)

More competition fishing & Hunting	3 (50%)
Eat away at amenities	1 (16 1/3%)
Mine is in elk country	1 (16 1/3%)
Might get swimming pool and tennis court	1 (16 1/3%)
	6 (99%)

15. Is there a problem of water pollution in Troy?

Yes	2 (13%)
No	13 (87%)
	15 (100%)

16. What? (Regarding Question #15)

Kootenai River	1 (50%)
Litter	1 (50%)
	2 (100%)

17. Is there a problem of noise pollution in Troy?

Yes	3 (20%)
No	12 (80%)
	15 (100%)

18. What? (Regarding Question #17)

Hotrodders	1 (25%)
Trucks	1 (25%)
Trains	2 (50%)
	4 (100%)

19. Would an increase in traffic or equipment noise be of much concern to most Troy residents?

Yes	2 (13%)
No	13 (87%)
	15 (100%)

20. Do residents feel "isolated" living in Troy?

Yes	2 (13%)
No	13 (87%)
	15 (100%)

21. If yes, do they like it or dislike it? (Regarding Question #20)

Like	1 (50%)
Dislike	1 (50%)
	2 (100%)

EXHIBIT 3

We have reviewed the research done by Linda L. Sootsman entitled "The Opinions of the Citizens of Lincoln County as they Relate to the Management of the Kootenai National Forest and the Functioning of Lincoln County Government". The pertinent information and data from that survey is presented here.

In this research a series of 28 questions were asked of the respondents, 25 of which were used in the write-up and of that 25 the following questions and the raw response data are judged pertinent to the quality of life considerations of this study. They are presented here for information and background only.

1. Do you think kids coming out of high school have an opportunity for work in this area?

Yes	8 (14%)
No	30 (54%)
Very little	17 (30%)
No opinion	1 (2%)
	56 (100%)

2. What do you think of the educational system in this area?

Good (Average)	33 (59%)
Lacking (Poor)	19 (34%)
No opinion	4 (7%)
	56 (100%)

3. How long have you lived here (in area)?

0 - 1 yr.	2 (4%)
2 - 5 yrs.	13 (21%)
5 - 10 yrs.	5 (9%)
10 - 20 yrs.	8 (14%)
20 - 30 yrs.	10 (18%)
30 - 40 yrs.	7 (13%)
40 & over	12 (21%)
	56 (100%)

4. Why have you stayed?

Like the area	34 (54%)
Husband or parents wants to live here	8 (13%)
Employment or business is here	21 (33%)
	53 (100%)

6. What can the County or area do to move forward or improve or change the area? or What can the people in the area do to move forward to improve or change the area?

People can be more interested and involved in community	50 (74%)
Like community as it is	10 (15%)
Can't do anything	3 (4%)
No opinion	5 (7%)
	68 (100%)

7. What would you like to see happen in the next ten years in this area?

Get some type of light industry or business into area for steady employment for people in area	19 (22%)
Leave area as it is now	12 (14%)
Improve Hwy 93 & Hwy 2 and streets and roads	6 (7%)
More planning in area	4 (5%)
Some slow growth	5 (6%)
Tourist trade develop	0 (0%)
Method to keep outsiders out of area	0 (0%)
Face lift of area	13 (15%)
Have more recreation in area	6 (7%)
Get people involved in area	1 (1%)
No opinion	4 (5%)
Need for housing in area	6 (7%)
A junior college in area and improvements of schools	9 (11%)
	52 (100%)

9. What is your feeling about the general friendliness of community?

Friendly	53 (98%)
Not friendly	0 (0%)
No opinion	1 (2%)
	54 (100%)

9A. Do you think it is hard for newcomers to get into the area?

No	37 (70%)
Depend on newcomer	11 (21%)
Yes	5 (9%)
	53 (100%)

20. What do you think about mining in this area?

For it	41 (79%)
Against it	7 (13%)
No opinion	4 (8%)
	52 (100%)

21. What do you see as problems in the area (or of area)?

Lack of employment	25 (28%)
Lack of public interest	4 (5%)
Alcohol problem	2 (2%)
Lack of diversified industries in area	1 (1%)
Lack of good housing	7 (8%)
Lack of stable economy	5 (6%)
Too much outside influences like gov't., etc. and gov't getting too big	6 (7%)
Too much welfare	9 (10%)
Lack of medical facilities	7 (8%)
Lack of facilities or activities for young and older people	6 (7%)
Lack of shopping facilities	1 (1%)
Lack of planning	3 (3%)
Need for better streets and roads	2 (2%)
Poor transportation is a problem	0 (0%)
Taxation is a problem	3 (4%)
No problems	2 (2%)
No opinion	3 (4%)
Lack of communication	2 (2%)
	53 (100%)

EXHIBIT 4

The other pertinent study previously referred to was done by Kathy Nielsen and was entitled "A Survey of Community Attitudes Among the Citizens of Troy, Montana Concerning a Copper-Silver Mine Proposed for that Region". In this survey, a random selection of 50 names from the Troy telephone directory were sent questionnaires. Thirty-seven of these questionnaires were returned for a return rate of 74 percent.

A series of eleven questions were asked, several of which have pertinence to a quality of life analysis. Exhibit 4 lists the entire questionnaire and the raw data responses obtained from the returned questionnaires. This information is included here, again, only for information and background.

1. Do you support or oppose the proposed ASARCO, Inc. silver and copper mine for Troy?

Support	21 (56.8%)
Oppose	13 (35.1%)
Undecided	3 (8.1%)

2. Do you believe ASARCO's assertion that no air or water pollution will result from the mine?

No	28 (75.7%)
Yes	8 (21.6%)
No comment	1 (2.7%)

3. Do you think the economic advantage (jobs and money) gained by having such a mine would outweight the environmental damage it may cause?

All respondents opposing the mine answered "NO"
Everyone supporting the mine answered "YES"

4. What secondary effects do you see resulting from the proposed mine? (Examples: pollution, population influx, broader tax base, etc.) Do you consider these good or bad?

	Number of Times Mentioned	Considered Good	Considered Bad
Population Influx, more people in area	27	8	19
Business & economic development, more money in area, broader tax base	15	9	6
More pollution, garbage, change of surrounding, eye-sores	13		13
More subdivisions, houses & trailers, residential develop.	4		4
More jobs for locals	4	4	
More crime, undesirable elements	3		3
Higher land prices, increase in value or real property	4	2	2
Demand on public services, schools	2		2
Effect on wildlife	2		2

5. Do you think ASARCO will be successful in their plan to reclaim the land they cover with the mine tailings?

Yes, or possibly	21 (56.8%)
No, or not completely	15 (40.5%)
Didn't know	1 (2.7%)

6. What changes do you see taking place in your own lifestyle if the proposed mine does go through? Are these changes good or bad?

	Number of Times Mentioned	Considered Good	Considered Bad
No change	18	--- Neutral ---	
Affected by decrease in qualities of land, peace and quiet, no pollution, scenery, aesthetics	6		6
More people, neighbors mobile homes to cope with	4		4
Affected by more money in town, expanded businesses, higher property value	4	3	1
Increased use of recreational facilities, campgrounds	3		3
Expanded school system will affect occupation	3	2	1
Will move away if mine comes into Troy	2		2
May get a job at mine	2		2
Fear of crime	1		1
Progress as end in itself	1	1	
Affected in future when mine closes and economic depression results	1		1
Increased medical care	1	1	1

7. Do you have any other comments you would like to make concerning the proposed ASARCO mine?

Numerous comments were recorded, these were considered as background to this most recent analysis.

APPENDIX R

Troy Housing Inventory Methodology

HOUSING STRUCTURAL CRITERIA

A. FOUNDATION

0 – Surface exhibits no visible signs of cracking, crumbling, or settling. Painted surfaces are not chipped or stripped.

1 – Surface is slightly cracked and in need of minor patching and/or painting to prevent problems which may arise from moisture penetration. There is no apparent crumbling or settling.

2 – Crumbling is evident and structure has begun to settle in severely cracked areas.

3 – No foundation or wooden foundation.

B. WALLS

0 – Wall surface is in excellent condition. Brick or plaster walls are not cracked at joints or wall openings. Aluminum, wood, plaster and other types of siding are painted or stained as needed for weather protection.

1 – Slight cracking is evident at mortar joints in brick or concrete block structures. Paint is chipped and cracked in places on other surface types. Some minor resurfacing work is needed (i.e., painting or patching).

2 – Surface is in need of major repair work. Brick and block assemblies must be reconstructed in certain areas. Other types of siding are broken or badly cracked and must be replaced.

3 – Wall surface is badly warped or broken. Weathering has caused extreme deterioration of the outside of the structure. Replacement is probably not economically feasible.

C. WINDOWS

0 – Window framing elements are neatly painted with no cracking evident. There are no readily apparent signs of air leakage around glass joints. Caulking and weather stripping are properly applied and not cracked.

1 – Paint and/or weather-proofing material has begun to crack or chip. Routine maintenance can alleviate the problem.

2 – Window frame is nearly entirely stripped of paint. Frame joints have begun to separate and/or structural alignment has been slightly altered. Caulking is missing in places. Partial reframing is necessary.

3 – Entire window unit is badly deteriorated. Framing members are badly cracked, broken, or warped. Reframing is necessary.

D. ROOF

0 – Roof surfacing material is apparently in excellent condition. Framing is not warped and flashing at joints and edges is not rusted or bent.

1 – Some weathering is evident on roofing material. Asphalt roofing has small pock marks visible and minor dents can be seen on aluminum roofs. Wood shakes are beginning to dry and crack. Flashing is slightly rusted or bent but roof framing is flat over the entire area.

2 – The effects of weathering on the exterior roof surface is prominent. Some shakes or asphalt tiles have broken loose or begun to crack or tear. Flashing is badly bent or rusted and some flashing nails are missing or loose. Some warping of framing members may be evident.

3 – The roof has begun to sag at the apex and/or warp through the center of the span. Roof surfacing material is missing or badly weathered throughout. The structure must be reframed before other improvements can be made.

E. CHIMNEY

0 – Chimney stands perfectly vertical with no visible signs of cracking or rusting.

1 – There is some evidence of weathering of the building material. Metal chimneys are slightly rusted and masonry chimneys have small cracks in some of the mortar joints. Chimney does not sag or lean.

2 – Crumbling and cracking is well advanced in masonry structure and metal chimneys are badly rusted and may be slightly bent. There may be some sagging or leaning.

3 – Some sections of masonry chimneys are missing or badly chipped. Rusting and/or denting and bending of metal chimneys has resulted in cracks or holes. Chimney structure is sagging or leaning.

APPENDIX S

Welfare Assistance Programs

J. Welfare and Social Services

(1) Public Welfare

The Lincoln County Department of Public Welfare provides economic assistance and welfare programs for residents of the county. The Public Welfare office is located in the County Courthouse in Libby.

The following section summarizes and gives a brief description of the welfare assistance programs available in the county.

(a) Aid to Dependent Children

Aid to Dependent Children provides money payments in behalf of dependent, needy children and in behalf of an eligible relative with whom the child is living. The Aid to Dependent Children program also covers day care costs for dependent children when the parent is in training or working.

An eligible relative, which includes parent or other individual having a blood or legal relationship with the child, may apply for Aid to Dependent Children for a dependent child under the age of 18 or between the ages of 18 and 21 years if regularly attending school, college, university, or vocational or technical training. Unwed mothers may also qualify for assistance during and after pregnancy.

(b) General Assistance

General Assistance is vendor payments paid from the county poor fund in behalf of needy persons to meet basic food, shelter, clothing, medical, or other emergency needs. Vendor payments are made to the person who supplies the above services.

To be eligible for assistance, an applicant must be in need in accordance with the state budget standards. The General Assistance program includes assistance to residents (persons who have resided one year in the county), non-residents (persons from out of state who are residing here), and transients who are passing through. Residence must be verified for purposes of state or county financial participation.

(c) Medicaid

The Medicaid assistance program provides medical care to recipients of public assistance, Supplemental Security Income and medically needy persons who are unable to pay for such care themselves. Medicaid includes medical or remedial care and services from physicians, surgeons, osteopaths, hospital care, family planning services, and medical screening for eligible persons.

Medicaid recipients must be eligible for assistance through Aid to Dependent Children or Supplemental Security Income. There is no residency requirement. The medical assistance program is available to those who meet budget standards.

(d) Food Stamps

The Food Stamp program is a federal program under the Food and Nutrition Service, Department of Agriculture. The program is administered in each state by the agency which handles categorical assistance programs. In Montana, the Department of Social and Rehabilitation Services has state administrative responsibility. The overall purpose of the Food Stamp program is to raise levels of nutrition among low-income households and to strengthen the agricultural economy.

The Food Stamp program offers coupons which applicants purchase for less than their redeemable face value. The stamps are used to obtain food items at a grocery store for the actual face value of the stamps.

There is no residency requirement for obtaining food stamps. However, applicants must file a financial statement verifying all income, resources, and expenses. Birth certificates, baptismal records, or other records of children living at home are required.

E. Social Services

The Social Services program of the Welfare Department is supervised by the Community Services Division of the Department of Social and Rehabilitation Services. A comprehensive listing of the Social Services available in the county is summarized below.

Basically, the eligibility requirements for obtaining any of these services is the same. T obtain Social Services, the applicant must demonstrate the need in accordance with budget standards. However, services required for the protection of a child or a mentally disabled person is provided without consideration of the individual's income or resources. Information regarding the eligibility requirements for the available Social Services programs can be obtained from the Lincoln County Department of Public Welfare.

(1) Day Care

Child care is available for a portion of the day in a licensed home or facility.

(2) Foster Care

Temporary or long-term placement of children is available in a licensed foster family home or group home facility

(3) Homemaker Services

Care of individuals in their homes, or assistance in providing adequate household and family management through the services of a trained and supervised homemaker are available.

(4) Health Related Services

Assistance for individuals to identify health needs and secure health services, to assure continuity of treatment, and to secure admission to appropriate care facilities is available.

(5) Home Management and Other Functional Educational Services

Instruction and training in management of household budgets, maintenance of the home, food preparation, consumer education, principles of child development, and how to cope with child rearing problems and related areas of family life are available.

(6) Housing Improvement Services

Assistance for families to obtain or retain adequate housing is available.

(7) Legal Services

Legal services as provided by the Montana Legal Services Association are available.

(8) Educational Services

Assistance for individuals to secure an education appropriate to their capabilities from available resources are available at no cost to the agency.

(9) Employment Services

Assistance for enabling appropriate individuals to secure employment or training leading to employment is available.

(10) Family Planning Services

Counseling and referral for family planning is available.

(11) Transportation Services

Transportation to community facilities and resources to obtain required services is available.

(12) Services to Unwed Mothers

Counseling relative to the problems of unwed pregnancies is available

(13) Protective Services

Protective services to children who are dependent, neglected, and/or abused are available. Protective services to adults who are unable to manage their affairs independently are also available.

(14) Services to Developmentally Disabled

Services are provided to allow the developmentally disabled person to return to or remain in communities. This includes placement in foster home and group home facilities. The services available are directed toward enhancing physical, social, and emotional development. Protective services are also available to the developmentally disabled.

(15) Information and Referral

Provision of information regarding services available within the agency and broader community are available. Referrals to appropriate resources are also provided.

APPENDIX T

United States Department of Interior Bureau of Mines Report on a Critique of the Proposed ASARCO Troy Project Mine and Alternative Technologies

United States Department of the Interior

BUREAU OF MINES

EAST 315 MONTGOMERY AVENUE
SPOKANE, WASHINGTON 99207

Western Field Operation Center
October 4, 1977

RECEIVED
KOOTENAI

OCT 7 1977

Mr. Floyd Marita, Supervisor
Kootenai National Forest
Libby, MT 59923

Dear Mr. Marita:

Enclosed are six copies of our answers to the questions your office asked concerning the Troy Project. For your convenience the questions are repeated as they were written in our letter of June 8, 1977.

Working with your staff on this project has been a pleasure. Please contact us if you wish to discuss these questions further.

Sincerely yours,

R. N. Appling, Jr., Chief
Western Field Operation Center

Enclosures

FES
ASB
A - R
B - F
C - S
E - P
OS
P - M
R - S
CO
ESB
C - M
F - P
I - A
S - D
P - C
PB 10/7
A - B 10-17
H - S
G
T - A 10/18
RSB
E - L
S - S
L - F
W - F
M
ALL
DRS

1. Comment on the studies done by ASARCO which led to the conclusion that mine roof collapse, with resultant surface subsidence would not occur. Also consider the risk of collapse by earthquake.

Rock mechanics data for analysis of mine roof and pillar strength was provided in Kennecott Copper Corporation interoffice memorandum number 388. These comments are based on that data.

Memorandum 388 should be considered a preliminary, rather than a final, engineering report because safety factor calculations are based on laboratory values for physical properties. This results in a best case analysis for pillar and roof safety factors; whereas for final design, a worst case analysis would be more appropriate. When applying laboratory test data to rocks in situ, certain in situ conditions which are not present in laboratory samples must be considered.

For example, the proposed 60 x 60-foot pillars would actually have an effective support area of about 55 x 55-feet because of fracturing in the pillar sides. This would reduce the support area by 16 percent. The compressive strength of the rock was given as 34,500 p.s.i., however, the laboratory samples tested ranged from about 8,000 p.s.i. to 71,000 p.s.i. Because in situ rock contains numerous cracks, flaws, and weaknesses, choosing a compressive strength in the lower range would be appropriate for final design. A more suitable value would be about 20,000 p.s.i. With a maximum overburden of 1,200 feet, a vertical stress of 1,380 p.s.i. can be expected. Thus, the pillar load would be 6,569 p.s.i. With these in situ conditions incorporated into the analysis, the pillar safety factor, pillar strength divided by expected stress, becomes 3.04. This is considerably less than the 10.45 factor stated in the memorandum.

A second area of consideration is the roof strength calculation. In memo 388, the analysis depends upon the tensile strength of the roof rocks. However, since the in situ roof rocks have numerous vertical fractures, their effective tensile strength should be considered zero. Calculated this way, the safety factor would therefore be zero rather than 4.7 as stated in memo 388. This conflict results from the choice of methods used for the calculations. The mine roof span design should use a zero tensile strength theory, such as the Vousoir arch theory which incorporates lateral forces to enhance roof support.

It is apparent from past earthquake history in Western Montana that sizeable earthquakes can be anticipated in the Troy area. While considering the risk of roof collapse by earthquake, discussions were held with the Corps of Engineers structural design group. They were responsible for earthquake analysis and design of the Libby Dam and Tunnel, which are comparable in scale to the proposed mine. From their investigations they determined that load factors of 1/10 to 4/10 G should be applied to account for possible particle acceleration due to earthquake. Applying the maximum 4/10 G factor to the in situ conditions outlined earlier results in a pillar safety factor of 2.17.

The conclusion to be drawn from this discussion is not that the rock mechanics work conducted by Kennecott Copper Corporation is wrong, but rather that they must be considered optimistic. The final mine design must be open to modification as more is learned of the rock mechanics conditions. Unfortunately, the only reliable laboratory for these tests will be the operating mine itself. Normally, a mining company continually studies and improves pillar design throughout the life of a room and pillar operation.

While high frequency earthquake energy may shake down loose and weak rock in the mine, the low frequency energy, which is potentially more dangerous, is not expected to cause catastrophic collapse of either the mine pillars or roof. Furthermore, a complete failure of a 60 x 60-foot pillar is very unlikely. Should it happen, or should a 60-foot roof span collapse, surface subsidence would be most unlikely. The roof rocks appear to be thick and competent enough to bridge the cave before it propagated to the surface.

2. Comment on the size and lifespan of the proposed operation, with consideration given to the economic and technical feasibility of varying the size and lifespan.

Your primary concern, as we understand it, is with the possibility of extending the life of the mine by planning a smaller scale operation to lessen environmental and socio-economic impacts on the area.

It is, of course, technically feasible to mine the Troy deposit at a much lower rate than that proposed by ASARCO. The question, therefore, is one of economics.

The methods and criteria used to test the economics of proposed mining ventures varies widely among mine planners. One of the most common methods is to compute the discounted cash flow rate of return (DCFROR) and compare with some minimum acceptable value. This minimum acceptable value also varies considerably from company to company. The Bureau of Mines normally uses 15 percent for a venture such as the Troy Project.

To determine the economic feasibility of extending the mine life, capital and operating costs were estimated for the operation at the proposed production rate of 8,500 short tons per day. Costs were then estimated for other production rates by applying scale factors to the base 8,500 ton-per-day costs. The comparative profitability of the different production rates based on average copper and silver prices for the last six months was then determined using the Bureau of Mines mine simulation computer program MINSIM4, which computes the discounted cash flow rate of return. No adjustments were made for inflation of future costs, or metal market fluctuations. The calculated returns on investment are plotted as a function of production life in figure 1.

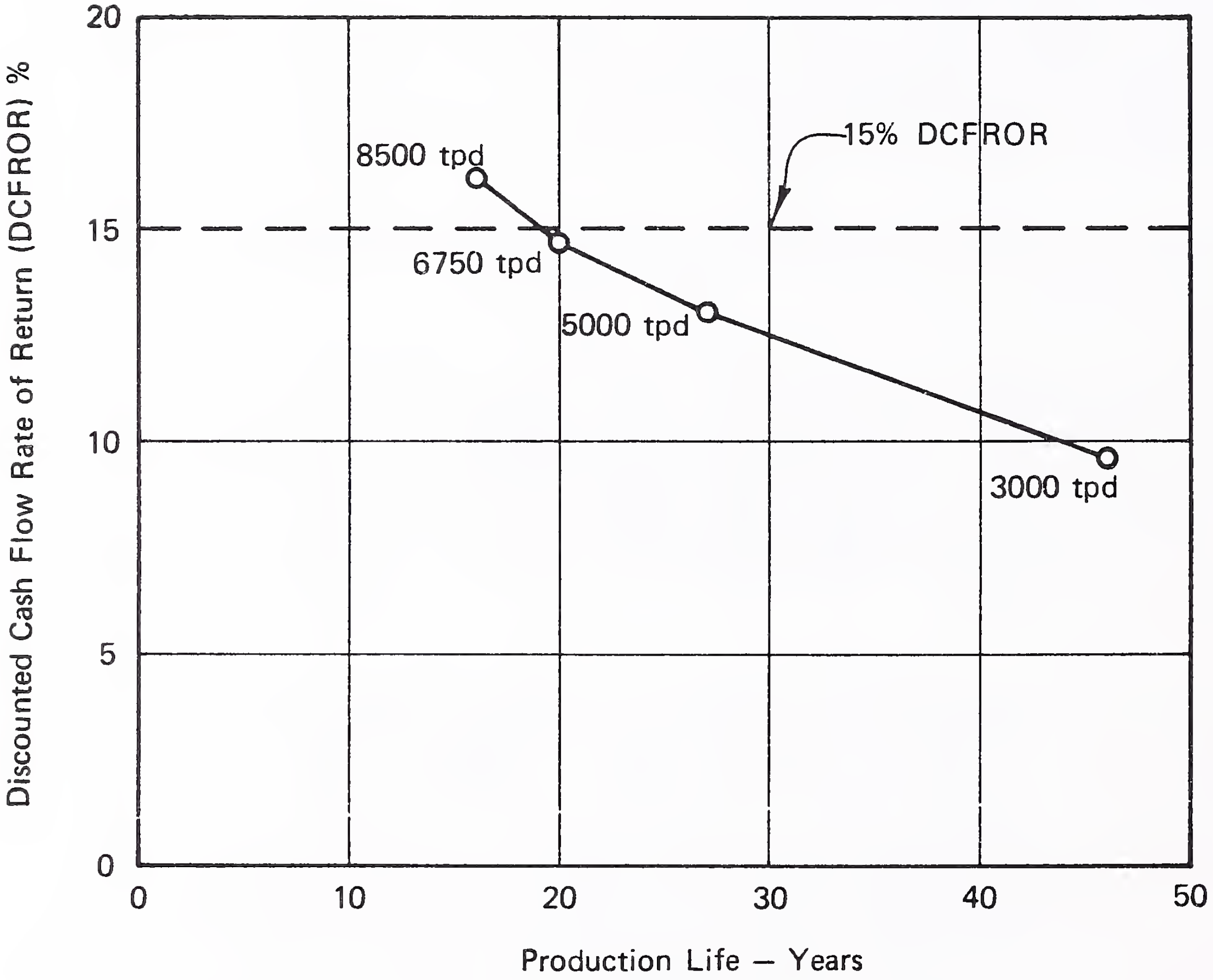

Figure 1. - Anticipated rate of return as a function of production life - Troy Project.

For all production periods greater than 19 years, estimated rates of return are less than 15 percent. The economic viability of such ventures must, therefore, be considered highly questionable. That the costs used in this analysis are merely estimates of average expected costs should be emphasized. Actual costs can vary widely depending upon the individual company's operational efficiency, variations in engineering design, unexpected conditions, and many other factors.

3. Comment on the tailings pond design, with special attention given to the long-term effect of tailings disposal at the proposed site.

   The tailings pond design as outlined in the Operating Plan has been modified and expanded upon in the report by Woodward-Clyde Consultants, entitled "Troy Project Tailing Impoundment Area Near Troy, Montana," dated May 3, 1977. The following comments and suggestions are based on that report.

   a. The plan calls for construction of a homogeneous dam; however, with the variety of materials available in the borrow area and a little supervision during construction, a better quality zoned dam could be built at little additional expense. The more impervious clay material should be placed on the upstream side with sand and gravel on the downstream side.

   b. The suggested 3:1 slope on the downstream side of the dam will make revegetation feasible. We suggest that this 3:1 slope be maintained between berms of about 20-foot width, which must be constructed every 30 feet of elevation rise to provide access for pipe handling.

   c. For decanting we suggest the use of two separate gravity decant lines and towers rather than a barge pump. The flat terrain does not lend itself to a deep clear water pool, therefore, the barge may have difficulties with mud. In winter, low pressure air would have to be bubbled around the barge to keep it free of ice. This action might agitate the water enough to keep the fines in suspension.

Some differential settling will occur as the tailing impoundment area is raised; however, the decant lines could be designed to accommodate this problem. Leaving the gravity decant lines in place upon abandonment of the pond would aid in drainage of the area and help to prevent formation of mud flats during wet seasons. If the gravity decant system were to fail, a barge system could be initiated at a later date, whereas the gravity decant system cannot be installed after the starter dam has been constructed and filling of the pond begun.

d. Movement indicators would probably not be installed on the starter dam until after the header pipe had been moved to the first berm above the starter dam, because with all the activity on an operating berm, they could probably be damaged.

e. The report recommends the tailings area not be divided in two parts, but we feel there would be distinct advantages in doing so. One half could be filled first while the other remains dry. Then, with another clear area available for tailings, the dike could be raised, the pipes moved, and the first area permitted to dry out. The ease of raising the dikes would more than offset the cost of building the intervening dike. The extra drying time gained by removal of an area from operation for 12 to 24 months also aids stability.

f. After the pond has been raised about 50 feet, a dynamic stability analysis should be performed on the tailings. The downstream slope should then be adjusted to improve stability, if necessary.

g. Open well or pneumatic piezometers or, better yet, both should be installed in the starter dam and out in the pond area 100 feet (±) before tailings are deposited. These will detect the water level in the tailings and aid in water management and stability determinations.

h. The tailing area is apparently underlain by a variety of materials, some of which are very permeable. Considering the proximity of the tailings disposal site to Lake Creek, we suggest that tailing slimes be laid down on the disposal site before deposition to prevent tailings water from entering these permeable zones. This is a relatively new procedure with which ASARCO has had some experience at their Sacaton mine in Arizona. At that mine, small diked areas were constructed and filled with 4 to 5 feet of slimes. That method will not work as well at the Troy Project because of the short frost-free season. We, therefore, suggest the following procedure:

After the area has been stripped of topsoil, it will be relatively smooth. The soil should then be ripped lightly to a depth of 6 to 8 inches every foot along the contour to hold the slimes in place when they are deposited on the ground. The cyclone overflow (slimes) could be sprayed through sprinklers, spigoted, or in some way deposited in a thin layer over one small area at a time and allowed to partially dry. A sheeps-foot roller could then work the slimes into the natural soil. To get a good seal the slimes should be deposited in several layers. With this method, a foot or less of cyclone overflow will provide the same sealing effect as can be attained with 4 to 5 feet of the same material in a diked area. The procedure could be accomplished in a much shorter time than by the diking method, and this would be very important where summers are so short.

i. The Woodward-Clyde report recommends that the outlet pipes which pass through the dam be perforated. Since the soil under the dike will probably be permeable, the outlet pipes may lose more water through the perforations than they pick up. We recommend, therefore, that these pipes not be perforated.

j. Abandoment. If a gravity decant line were used as suggested in comment c rather than the barge pump, the pond in the tailings area could be drained and kept drained to facilitate revegetation. Without the decant line, there would be a lake part of the year, which could be dangerous because of the muddy bottom.

k. General. The proposed site appears to be well-suited for tailings disposal and the plan is adequate. We are familiar with ASARCO's tailings disposal areas in other parts of the country and find them, in general, to be well designed and operated.

4. Consider alternatives to the proposed tailings disposal plan, especially the alternative of replacing the tailings in the mine.

Dump, heap, and in situ leaching, direct shipping of ore, and milling at a remote location, which are discussed as alternatives to the proposed mining and milling methods under question seven, would all result in either elimination or displacement of the tailings disposal site.

Hydraulic placement of tailings in mined out portions of stopes is practiced in many vein mines where the tailings can be used to advantage in the mining operation. The dewatered tailings provide a working surface for continued drilling, blasting, and mucking in the stope, and they prevent sloughing of large rocks from the stope walls. The cost of this procedure is warranted where ore grade is high. The system replaces other more costly procedures such as square-set timbering, and it reduces the amount of surface storage required.

Originally tailings were thought to provide considerable ground support; however, it is now known that the strength of the tailings is so minor that they provide little support. Methods are being developed to improve the support capabilities of tailings, such as electrokinetic dewatering and addition of cement; however, their strength remains minor even after these techniques are applied. What little strength exists is largely a result of confinement.

At the Troy Project, no technical advantage for the underground operation would be gained by storage of tailings in the mine. The working surface is not necessary; no ground support can be anticipated, particularly because of the lack of confinement; and any advantage the tailings might provide in the way of preventing sloughing would be largely negated by the time lag which would be required between blasting and placement of tailings.

With some modification in mine design, some tailings might be stored underground if the objective were to reduce surface storage requirements. The wide square rooms would have to be modified to long narrow openings to reduce the size and number of bulkheads required. Production scheduling would have to be modified to provide inactive mined out areas for filling. Removal of the tailings water from the mine would be a minor problem since no pumping would be required.

If an underground storage system were initiated, about 60 percent of the tailings would still have to be stored on the surface as a result of expansion of material, inability to fill stopes to the top, and inability to schedule tailings placement and mine production with sufficient efficiency to fully utilize all available storage space.

Underground storage might improve the possibilities for a successful pillar recovery program, resulting in improved resource recovery.

5. Examine the adequacy of a 69 kv power supply line to meet project power needs.

   We understand this question is no longer a point of concern and need not be considered in this report.

6. Comment on the technical and economic feasibilities of the proposed mining and milling methods.

   Mining Method

   The mining plan proposed by ASARCO is a standard room-and-pillar system, the most common large-scale underground mining method in use today in the United States. It is, therefore, a well-tested method which can be applied with a high degree of confidence under appropriate conditions.

   The physical conditions favorable to a room-and-pillar operation are generally accepted to be the following:

   a. A relatively flat-lying deposit.

   b. Relatively uniform ore thickness and grade.

   c. No severely deformed rocks.

   d. Competent roof and floor rocks.

   e. An areally extensive deposit.

According to the deposit description in ASARCO's operating plan, the Troy ore body has a maximum dip of 8 degrees. This is within the dip limitations for room-and-pillar mining. The average ore thickness of 60 feet is well suited for a room-and-pillar operation; however, the operating plan contains little information as to the variability of thickness or grade. Rock deformation appears minimal. Two major faults are described. The East fault, striking north-northwest, is the east boundary of the ore body and should not interfere with the mining operation. The east-west cross fault, which offsets the south one-third of the deposit 210 feet higher than the north part of the deposit, will cause some complications but can be accomodated by proper mine design. Rock strength, which is discussed more fully under Question 1, appears adequate. The ore zone, being 7,400 feet long by 1,800 feet wide, has sufficient areal extent for a large-scale room-and-pillar operation.

The Troy deposit, therefore, is amenable to the proposed room-and-pillar system. The method has many environmental, technical, and economic advantages compared to the alternative methods discussed under Question 7. Some of these are:

a. Much of the development work takes place in ore. This partially offsets development costs and reduces the size of waste dumps on the surface.

b. The method is amenable to the use of high-capacity equipment.

c. The large number of working places results in high productivity.

d. Adequate ventilation, particularly important when diesel equipment is used, is relatively easy to achieve.

e. The method is highly flexible and can be modified throughout the mine's life to take advantage of new technological developments and to adapt to changing conditions.

f. High selectivity is possible. Rooms can be easily started or stopped without serious effect on the operation as a whole.

The system does have some disadvantages; the major ones are:

a. Roof support and maintenance of the large openings can become costly.

b. The ore extraction ratio is reduced because pillars must be left to support the openings and prevent subsidence. In the present case, unless pillar recovery ensues, 25 percent of the ore will remain as pillars.

c. The method is not readily amenable to underground disposal of mill tailings.

Milling Method

Modern day copper mining operations generally produce low-grade ore, normally within the range of 0.4 to 1.0 percent copper. Because of resultant uneconomic transportation costs, these ores must be reduced on site as much as possible. On-site processing, or milling, reduces substantially the amount of material which would otherwise be transported to the smelter for further processing. This sizable reduction of the tonnage of material to be shipped and the attendant reduction of transportation charges make mining of these reserves economically sound. The flotation mill proposed for the Troy project will produce a concentrate which will be only 2 percent of the amount of original ore mined.

Technologically, the flotation method proposed for the Troy Project mill (see pictorial flow diagram provided by Kaiser Engineers) is well established as the best means for concentrating the contained copper ore minerals. More specifically, this plant will process the ore in several stages (crushing and grinding, flotation, concentrate filtering and drying, and tailings disposal) all of which are standard in the industry today. These processing stages have well established technologies and it is improbable that any significantly beneficial variation, either economically or environmentally, can be proposed.

Crushing and grinding are essential, as preparatory phases, to achieve maximum separation between ore and gangue minerals in the flotation units. Much of the induced breakage occurs along grain boundaries and, as a result, the flotation cell feed consists of relatively pure particles of either ore minerals or gangue minerals.

The flotation process separates the ore mineral particles from the worthless gangue mineral particles by preferentially floating the ore mineral particles in a pneumatically-generated froth that is allowed to overflow the top of the cell. This froth will contain the ore minerals and is gathered in launders and transported to the thickening and filtering section. Here water is removed from the resultant pulp in preparation for shipment to the smelter. The waste or gangue minerals are removed from the flotation cells and sent to the tailings pond for disposal.

Economic Feasibility

In order to determine the economic feasibility of the proposed mining and milling methods, capital and operating costs were estimated for the operation. The profitability of the operation at average copper and silver prices for the last six months was then determined, using the Bureau of Mines mine simulation computer program MINSIM4, which computes the discounted cash flow rate of return. No adjustments were made for inflation of future costs or metal market fluctuations. This analysis determined that an estimated discounted cash flow rate of return (DCFROR) of about 16 percent can be anticipated for the Troy project.

As discussed under Question 2, the minimum acceptable rate of return varies considerably from company to company, therefore, no particular value can be considered applicable to all companies or all projects. For a mining venture such as the Troy Project, the Bureau of Mines normally uses a minimum DCFROR of 15 percent to test for profitability. According to this test, the Troy project, as proposed, can be considered economically viable.

7. Consider alternatives to the proposed mining and milling methods for technical and economic feasibility with a discussion of the strong and weak points of each method.

In a search for viable alternatives to the proposed mining method, all of the standard mining systems were examined for applicability to the Troy deposit. These systems are discussed individually below.

A. In Situ Leaching

The term "in situ leaching," as used here, means the chemical extraction of metal values from ore without removal of the ore from, or disturbance in, its original geologic setting, other than fracturing in some way to improve the ore's permeability. It involves percolating fluids through an ore body to dissolve the ore minerals and carry the metal values in solution to a collection area. The fluids are then processed to cause precipitation out of solution.

The method has been applied very successfully to certain types of uranium and copper deposits, particularly to deposits which have been partially mined, with large tonnages of low grade broken ore left in the ground. When used appropriately, the method has the advantages of low capital and operating costs, minimal environmental disturbance, no surface subsidence, and conservation of resources by extraction of minerals which could not be profitably extracted by any other means. Groundwater pollution can be a significant danger, but on the other hand the threat of seepage from waste dumps and tailings ponds is completely avoided.

For a deposit to be amenable to in situ leaching, it must possess the following characteristics:

a. It must contain ore minerals which can be readily dissolved.

b. The deposit must be naturally permeable or capable of being made permeable.

c. It must be underlain by a barrier rock that directs solutions to a recovery point.

d. A hydrometallurgical method must exist to extract the valuable metals from solution.

e. The host rock must be non-acid-consuming.

f. An abundant supply of low cost water must be available.

The Troy deposit possesses certain characteristics advantageous for in situ leaching and certain characteristics detrimental to in situ leaching. The advantageous characteristics will be discussed first.

a. The quartzite host rock would probably be non-acid-consuming. However, we understand that some beds of the overlying St. Regis formation may be calcareous. If the leach solution had to penetrate these rocks, it would be partially neutralized.

b. The mountainside location of the deposit would make it possible to recover the pregnant solutions by gravity drainage.

c. The metal values are in minerals which can be leached, but with some difficulty.

Factors detrimental to in situ leaching are:

a. The host rock appears to have very low permeability.

High permeability is necessary to allow the leach solution to pass through the rock in a reasonable length of time and contact a high percentage of the ore mineral grains. Permeability could be improved by blasting the entire deposit to create a fracture system through which the solutions could flow. This would require the excavation of extensive openings in the deposit to provide access for the placement of explosives and to provide room into which the rock could expand during the blast. An example of the amount of workings and explosives necessary to accomplish this was demonstrated by a copper mine in Arizona, where recently 6,000 feet of 6 x 6 feet tunnels were excavated and 4,000,000 pounds of explosives were used to shatter a 4,000,000 ton orebody for leaching purposes.

Considerable testing would be required to determine the degree to which the orebody could be fractured by such a blast. With the ore minerals disseminated rather than concentrated on fracture surfaces, it is doubtful that blasting could create sufficient permeability to expose a high percentage of the minerals to attack by the leach solution. For this reason, metal recovery would be very low, even if the blast were highly successful.

b. The depth, tabularity, and horizontal orientation of the orebody are not conducive to an efficient in situ development plan. Extensive workings would be required at the top and bottom of the deposit to distribute the barren leach solution and collect the pregnant liquor, thus increasing capital and operating costs considerably.

c. Copper and silver could not be simultaneously recovered from the deposit. Normally copper is recovered by an aqueous acid leach process, and silver by an aqueous cyanide solution process. The acid and cyanide solutions react together to produce deadly cyanide gas.

The low cost and low environmental impact of in situ leaching warrant its consideration for any new mining operation. However, the Troy deposit°s low permeability, tabularity, horizontal orientation, depth, and dual metal character make it a highly unlikely candidate for a successful in situ leaching operation.

B. Sublevel Caving

Sublevel caving is a mining system whereby sublevel drifts are driven through the orebody at regular vertical and horizontal intervals. These drifts provide access to the orebody for drilling and blasting to induce caving. As in block and panel caving, surface subsidence results from such an operation.

To be suitable for sublevel caving, an orebody should be large, with moderate strength and readily cavable walls that dip 60° to 90°.

Probably the Troy Project wallrocks would not cave properly, and the relatively flat dip of the orebody would make dilution control difficult, and greatly reduce mining efficiency at the contact areas. Therefore, sublevel caving should not be considered a viable alternative mining method for the Troy Project.

C. Block Caving and Panel Caving

Block and panel caving systems exploit the weaknesses inherent in a rock mass by using the force of gravity to effect both the breakage of ore and its movement to loading points.

Caving of a block or panel of ore is made possible by undercutting and removing at depth the natural support for the rock in a large controlled lateral area. The overlying rock then fails in tension and falls into the void of the undercut, which must have a lateral area large enough to prevent the formation of natural arches. After caving begins, the broken rock is drawn off through an arrangement of ore passes at a rate that allows continuous caving. As caving progresses, a large subsidence area develops at the surface.

Caving can be one of the most efficient underground mining methods; however, only certain types of ore bodies are amenable to caving operations. For caving to be successful, the rock must be weak enough to cave readily and break into fragments small enough to pass through ore chutes. Also, the deposit must be large and massive with considerable vertical extent.

Based on a visual examination of the ore in place and analysis of the rock mechanics test data presented to us, we conclude that the Troy Project rock is too competent to cave properly. In addition, the deposit does not have sufficient vertical dimension to pay for the extensive development work which would be required beneath the ore body to initiate a caving operation. For these reasons, block or panel caving cannot be considered a viable alternative mining method for the Troy Project.

D. Sublevel Opening Stoping

Sublevel open stoping entails providing access to the ore body at various subintervals between main haulage levels in order to drill and blast the intervening ore. Stope drilling is carried out from drilling drifts on the sublevels, and the ore is blasted in slices towards an open face. The blasted ore gravitates to the bottom of the stope and is collected through drawpoints. When properly utilized, the system results in no surface subsidence.

The main criteria for sublevel open stoping are: 1) strong ore and country rock; 2) regular ore boundaries; and 3) a footwall dip that exceeds the angle of repose of broken ore.

The angle of repose of broken Troy Project ore would be about 35° to 40°. The maximum dip angle of the Troy Project deposit is about 8°. The dip on the footwall would, therefore, not be sufficient to allow blasted ore to gravitate freely to the drawpoints. The method, therefore, would not be successful if applied to the Troy deposit.

E. Shrinkage Stoping, Cut and Fill Stoping, and Square Set Stoping

These systems are all designed to handle the irregularities and ground support conditions of vein mining. They are flexible and selective, but expensive and typified by low productivity. The conditions for which they were designed do not exist at the Troy Project and their high costs eliminate any possibility of using them for such a low grade deposit.

F. Surface Mining

Surface mining methods are technically feasible for the Troy orebody. However, most of the deposit is too deeply buried to make such a venture economically feasible. Surface mining would also have a considerably greater environmental impact than the proposed method. More land area would be disturbed for the pit, waste dumps, and haul roads. Blasting and hauling of both ore and overburden would cause considerable noise and dust, and more energy would be consumed in breaking and removing overburden. Surface mining, therefore, should not be considered a viable alternative mining method for this deposit.

G. Modifications of the Room-and-Pillar System

Innumerable modifications of the room-and-pillar method could be proposed for the Troy Project. These modifications would probably not result in any significant variation in environmental disturbance from the proposed system. Any proposal resulting in pillars with a ratio of the least pillar dimension to pillar height that is less than one (1) should be very carefully examined because instability is introduced when this ratio is less than one (1).

Technically feasible alternatives to the proposed milling scheme are direct shipping of ore, leaching, gravity concentration, and milling at a remote location. Each of these alternatives is discussed individually below.

A. Direct Shipping of Ore

Shipping of the ore directly from the mine to the smelter without the intermediate milling step would eliminate the mill facility at the mine site and the tailings pond near Lake Creek. It would, however, result in considerable haul-truck traffic, with enormous consumption of energy for hauling and smelting. For economic reasons alone, this alternative cannot be seriously considered. The cost of hauling and smelting such large amounts of low-grade ore would greatly exceed the value of the ore.

B. Leaching

Leaching can be roughly classified into three categories--in situ, dump, and heap leach. In situ leaching is discussed elsewhere in this report. Dump leach is a method normally employed to extract copper from low-grade ($\leq$0.3 percent copper) waste that is moved during normal mining operations. This method allows for the partial recovery of a resource which would otherwise be completely lost.

The leach material is normally placed in dumps as mine run rock and not crushed or otherwise further processed. The leach time is normally 3 to 20 years, depending upon the proportion of oxide to sulfide copper minerals. As the material to be leached becomes relatively enriched in sulfide minerals, the necessary leach time for recovery of the contained copper increases. The conclusions to be drawn from this are that dump leaching of the amount of material which will be involved in the Troy Project would necessitate the stripping of large areas on which to place the dumps; the time required for continual leaching indicates that the dumps would have to be maintained without reclamation for at least 20 years, and finally, unless excessively costly precautions are taken, the leach liquors would always pose a major threat to the quality of the local groundwater.

Heap leaching is much like dump leaching except that large asphalt pads are constructed upon which the ore is placed, and a somewhat stronger acid solution is used. For economic operation, this process requires that the copper be contained in the form of acid-soluble, oxide minerals to allow a reasonable cycle time for each pad. The sulfide ore of the Troy Project does not meet this requirement; therefore, either dump or heap leaching is not an economic alternative to the proposed milling method.

C. Gravity Concentration

Gravity concentration is the beneficiation scheme which would have been employed if the mill were constructed in the early 1900°s, prior to the development of flotation. This method takes advantage of density differences to separate the ore minerals from the gangue minerals, which are normally lighter. The devices employed (tables and jigs) are most effective when the grains of valuable minerals are coarse. Because the chalcopyrite and other copper minerals are fine-grained at the Troy Project, gravity concentration would be marginally effective in separating the ore and gangue minerals.

An additional consideration, and one upon which the economic decision would be made, is the much lower copper recovery characteristic of gravity as opposed to flotation mills. Only 40 to 60 percent recovery of the contained copper values can be contemplated in a gravity mill, whereas 90 percent recovery (in a substantially higher grade concentrate) can be anticipated in a flotation mill.

D. Milling at a Remote Location

A millsite location environmentally more desirable than the proposed site might be found. However, if this were done, haulage costs would become a prime consideration in determining economic feasibility. Financial analyses were performed for theoretical operations according to the procedures outlined under Questions 2 and 6 with all conditions similar to those proposed, except for varying haul distances. The results are plotted in figure 2. This graph shows that as distance between mine and mill increases, economic justification for the venture rapidly decreases.

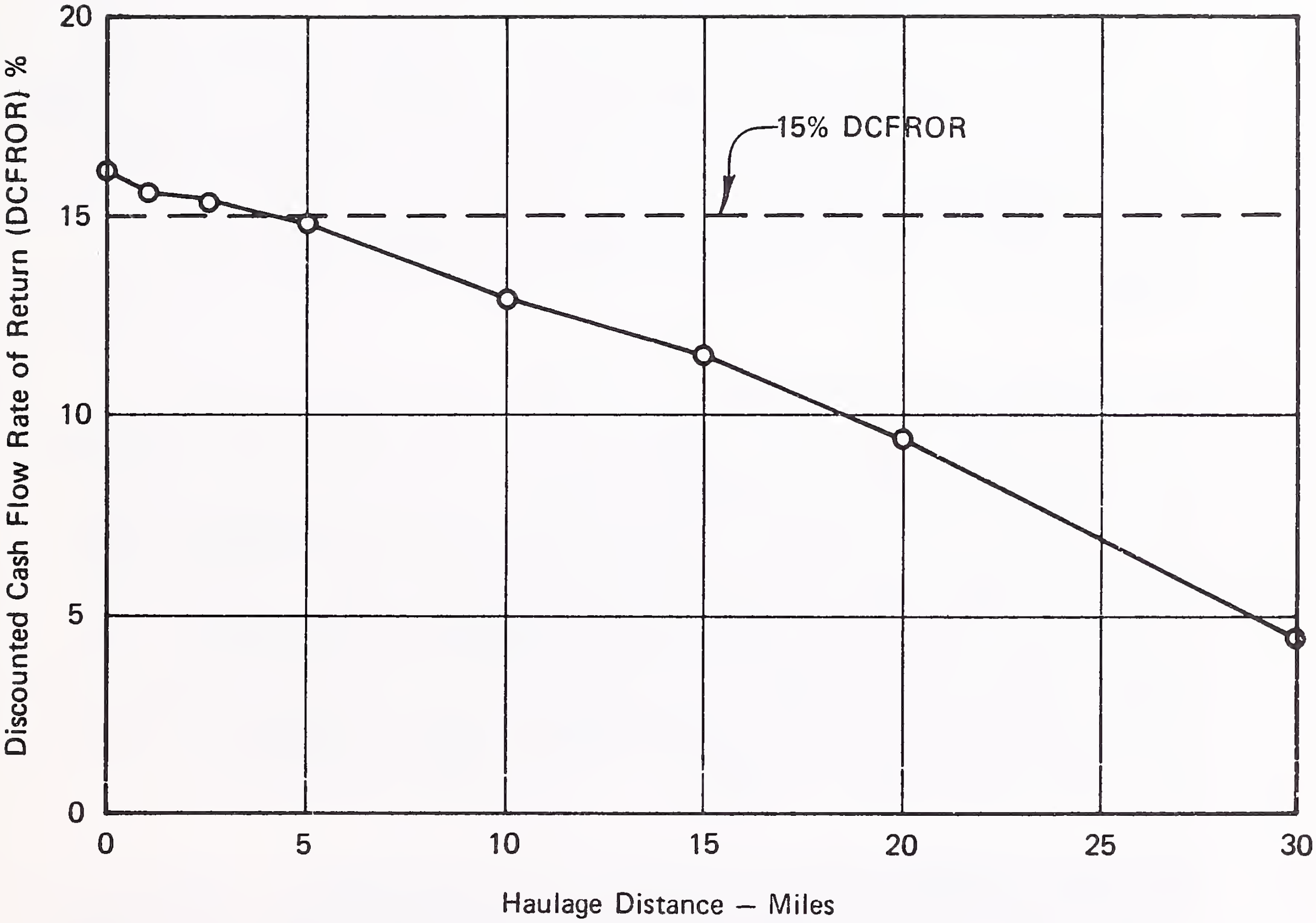

Figure 2. - Anticipated rate of return as a function of haulage distance between mine and mill - Troy Project.

8. Check the accuracy of data presented in the operating plan concerning the quality of air and water discharge.

Water quality data contained in the Troy Project Operating Plan are insufficient to assess either the method leading to their computation, or their appropriateness in relation to technologic and environmental constraints. The data presented on page 16 of this operating plan represents water quality at an intermediate stage in processing, namely the tailings pond influent from the mill. Unfortunately, neither water quality of a surface point source discharge nor underground seepage can be inferred directly from this information. The list of pollutants in the report includes only the mill reagents. No information is provided concerning the possible presence of heavy metals, such as copper, zinc, cadmium, and mercury, etc., which can be environmentally damaging.

The tailings pond environment removes some pollutants naturally through alteration of toxic compounds into relatively stable non-toxic forms and precipitation and flocculation of these. To predict with accuracy the quantity of reagent which will be carried by the tailing area effluent is difficult. A study of this subject was conducted by the Ontario Ministry of the Environment.[1] This study concluded that "only very rarely will any specific commercial reagent exist in the effluent from a typical tailings area in concentrations greater than 5 parts per million. Only occassionaly will any specific commerical reagent exist in the effluent from a typical tailings area in concentrations greater than 3 parts per million. The most common concentration of a commercial product in a typical tailings area effluent appears to be 2 parts per million or less."

Toxicity tests were also performed on selected reagents as part of that study. _Daphnia magna_ (a small crustacean), _notropis atherinoides_ (emerald shiner), and _pimephales promelas_ (flathead minnow) were used for the tests. The following partial results of those tests and other comments are quoted directly from the study report:[1]

---

[1] The Use Characteristics and Toxicity of Mine-Mill Reagents in the Province of Ontario, John R. Hawley, Ontario, 1977, 244 p.

"Potassium Amyl Xanthate

At temperatures above 30 degress C, low concentrations (of xanthate), and exposure to acidic conditions, decomposition of xanthates is extremely rapid."

"Product A

Organism	Toxicity Range	Toxicity
D. Magna	0.1 to 1.0 ppm $^{W}/v$	high toxicity
N. Athernioides	10 to 100 ppm $^{W}/v$	moderate toxicity
P. Promelas	1.8 to 18 ppm $^{W}/v$	moderate toxicity
	Product B	
P. Promelas	18 to 180 ppm $^{W}/v$	moderate toxicity"

"Pine Oil

Little information has been generated concerning the toxicity of pine oil and pine oil products. The following, however, concerning the toxicity and biodegradability of pine oil, was supplied by one company (Hercules) and does give a very valuable indication of the toxicity of pine oil and pine oil based products. The information is quoted verbatim from a company publication:

> "'The statements below, from the laboratories of Ryckman, Burbank, Edgerley, and Associates (St. Louis, Missouri) summarize their biodegradability studies on Hercules Yarmor, a typical high-grade commerical pine oil. The studies were conducted to establish a basis for reply to the question, "Is this product biodegradable?"'"
>
> "The Yarmor pine oil was introduced in the following systems in the form of a mixture comprised of 80% pine oil, 10% fatty acid soap, and 10% water.
>
> "'Fish Toxicity: 46-69 ppm was a median lethal concentration to bluegill fingerlings when exposed for 24-48 hours. This same species of fish survived when exposed to an effluent of an activated sludge treatment plant which was fed 50 ppm of contaminant (pine oil). This fact confirms the removal suggested by a river die away study.

> "'River Die Away: If a pine oil was discharged into a surface body at a concentration of 5 ppm, the contaminant would be degraded to approximately the same extent as sewage with about half of it decaying each 6.5 days. Fish toxicity would not be expected (5-day B.O.D. = 0.8 mg. oxygen/mg. pine oil).
>
> "'To summarize these data on pine oil, the material can be called degradable, and if it were discharged into a surface water, the fish life should not be affected.'"

"Dow froth 250

Organism	Toxicity Range	Toxicity
P. Promelas	greater than 1,000 ppm $^{v}/v$	relatively non-toxic"

Air quality is not specifically addressed in the operating plan. Historically, air quality has not been a major environmental problem in base metal mining or milling, and is not anticipated to be such at the Troy Project. Two sources of dust can be identified; one will be the movement of equipment on unsurfaced roads, and the other will be rock crushing. These can be readily alleviated by spraying roads during summer months and by installing dust collectors at appropriate points around the primary and secondary crushers and associated conveying and storage facilities.

9. Make a general examination of the operating plan for possible flaws or omissions.

Numerous minor technical details of the proposed mining and milling system have been omitted from the operating plan. Sufficient information is provided, however, to recognize that the proposed room and pillar mining system and flotation milling system will utilize standard, well-known procedures. Elsewhere in the report, reference is made to considerations that cannot be evaluated from the information provided. However, except as mentioned, the detailed information omitted from the operating plan does not involve any significant environmental risks, so far as we can tell.

Several suggestions for improvement of the plan have been given in the foregoing comments. With respect to Question 3, the proposed plan for the Troy Project includes recycling to the mill all waste water from the tailings area which is not retained intergranularly, or lost through evaporation and seepage from the disposal site. Therefore, no point source of water pollution is anticipated, and the operation probably will not fall under existing legislation relating to water quality. It may be prudent, however, to consider the recent trend towards inclusion of the quality of subsurface waters under the purview of the Environmental Protection Agency and comparable state agencies. This trend would indicate that a careful assessment should be made regarding the possibility that abatement of this type effluent may be required in the future. Incorporation of seepage control techniques such as those suggested under Question 3 in initial design and construction will result in more effective pollution abatement than any techniques which might be incorporated at a later date.

United States Department of the Interior
BUREAU OF MINES
EAST 315 MONTGOMERY AVENUE
SPOKANE, WASHINGTON 99207

Western Field Operation Center
November 23, 1977

Mr. Floyd Marita, Supervisor
Kootenai National Forest
Libby, Montana 59923

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Dear Mr. Marita:

Mr. William O'Brien asked us to clarify two comments made in our report to you concerning the Troy Project. These statements are discussed individually as follows:

Page 5, Comment 3.a.:

The term "homogenous dam" as used in the Woodward-Clyde report is assumed to mean a dam constructed of a uniform mix of materials throughout. That is, the material has not been sorted by type (clay, sand, gravel, etc.) and placed in different parts of the dam. We recommend that, because a variety of materials is available, a zoned starter dam should be constructed as depicted on the attached sketch. The more impervious clays should be placed on the upstream side, the sand and clay mix (if any) in the middle, and the sand and gravel on the downstream side.

The reason for this is that any water seeping through the upstream face should be free to flow through the dam without saturating it. The downstream two-thirds of the starter dam should be kept dry; by doing this stability of the dam will be maintained enabling it to hold the saturated upstream one-third in place. This precaution should be taken in addition to the drain construction recommended in the Woodward-Clyde report.

If you have not already done so, we would suggest that additional contact with an agency such as the Bureau of Reclamation or the Corps of Engineers could be most desirable with respect to questions of dam construction adequacy.

Page 5, Comment 3.b.:

Revegetation of tailing dike slopes steeper than 3:1 is extremely difficult. We therefore suggest that while slightly steeper slopes on the downstream side of the tailing dike may be adequate for stability purposes, these slopes should be constructed no steeper than 3:1. As depicted on the attached sketch, this 3:1 limit should be applied to the slope between berms, rather than to the overall slope which must therefore be flatter than 3:1. Berm widths and elevation differences will depend upon operational requirements; however, if they are 20 feet wide with 30 feet of elevation difference between them, the overall slope will have to be 3.6:1 or flatter in order to maintain the 3:1 limit on the slopes between berms.

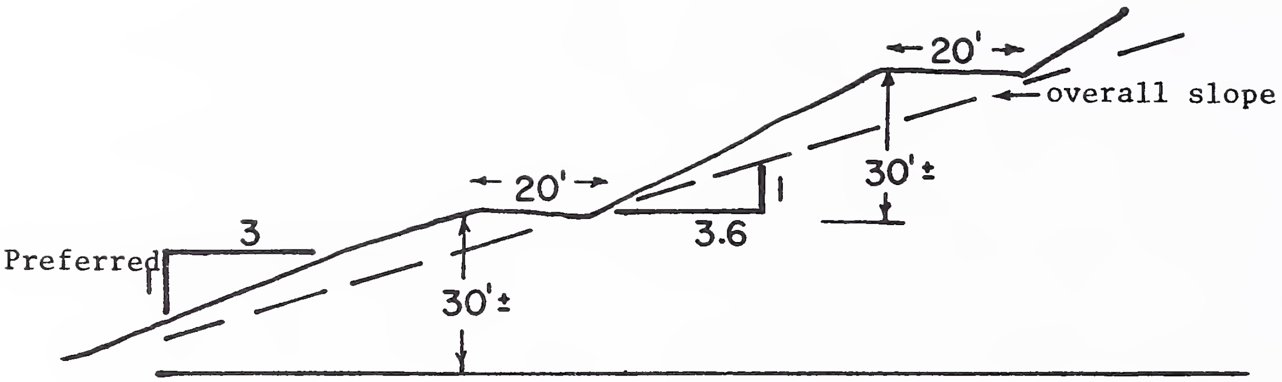
We hope this explanation clarifies the comments for you. If you have any further questions, please contact us.

Sincerely yours,

Kenneth D Baber

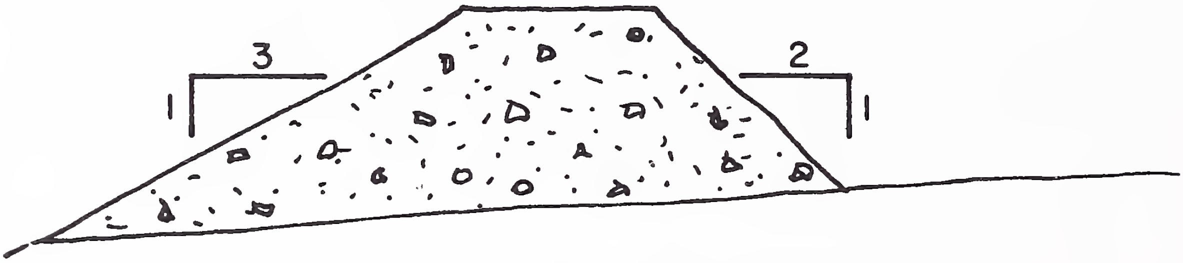
K. D. Baber, Acting Chief
Western Field Operation Center

Enclosure



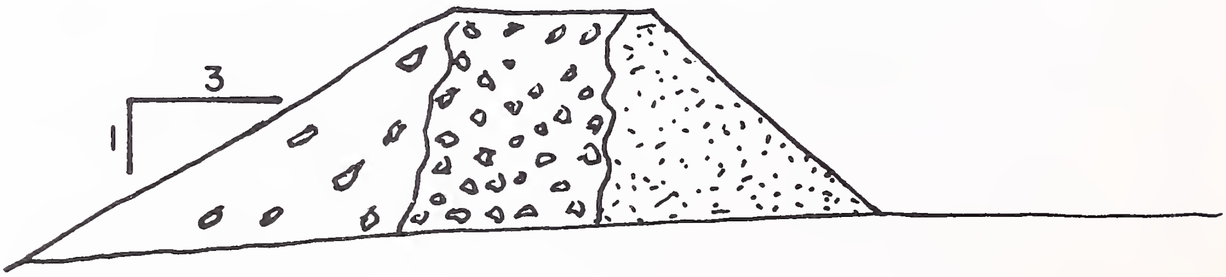
Preferred-for vegetating ease

TAILINGS SAND DIKES



Permeability uniform throughout

HOMOGENEOUS STARTER DAM



← Permeability increase downstream

ZONED STARTER DAM

APPENDIX U

General Methodolgy for Projection of Employment and Population

General Methodology

There are two general and commonly used methods for projecting population levels. The first utilizes a procedure known as a cohort model. The second projects population as a function of expected employment.

The cohort technique begins with data found in a decennial Census like the 1970 Census. These data include the number of individuals in each one-year bracket (cohort) by sex. Fertility rates are applied to females given their age, and survival rates are applied to all individuals given their age. A simple yearly tally of the difference between expected births and deaths is maintained and in turn added to the 1970 level. The procedure provides a projection of the "natural growth" of the area in the absence of migration. The following example illustrates the process.

Assume that in 1970 the age and sex composition of county x was a follows:

	Males	Females
0 but less than 20 years	20	20
20 but less than 40 years	20	20
40 but less than 60 years	15	20
60 but less than 80 years	10	10
greater than 80 years	5	5
Total	70	70

Furthermore, assume that the following vital rates were indicative of the area:

	Survival Rates		Fertility Rates
	males	females	females
0 but less than 20 years	.99	.99	.20
20 but less than 40 years	.95	.95	.90
40 but less than 60 years	.90	.90	.01
60 but less than 80 years	.85	.85	.00
greater than 80 years	.20	.20	.00

Since the example is expressed in twenty year intervals, the 1990 level in the absence of net migration would be equal to 146 or:

natural
survival: (20) (.99) + (20) (.99) + (20) (.95) + (20) (.95) +
(15) (.90) + (15) (.90) + (10) (.85) + (10) (.85) +
(5) (.20) + (5) (.20)
plus
expected
births (20) (.20) + (20) (.90) + (151) (.01)

The difference between the example and actual cohort models is that actual models usually apply rates to shorter yearly intervals, e.g., single years.

Cohort models of this nature are generally more reliable for a larger self contained area such as the nation. That is, vital rates necessary for projection are relatively stable and as a result the population forecast is usually accurate. However, in small areas significant error is possible since the technique in its simplest form ignores migration flows associated with changes in the general level of economic activity. In Lincoln County this problem is particularly difficult. Since 1970, the base year for the cohort model, numerous residents have left the area. This decline as reflected in the Bureau of the Census P-26 data series indicates that between 1970 and 1976 the total population level declined by approximately 1700. Most of this decline was associated with the completion of the Libby Dam. In addition to the inability of cohort models to be influenced by such changes, the projections produced by such a system are even further in error since all of the temporary construction workers were included in the 1970 base data which would serve as a starting point for a cohort model. In Lincoln County the exclusive use of such a system for projecting further population levels would be clearly in error.

In order to avoid this problem another technique was developed to provide population forecasts based on a combination of the expected level of economic activity and a modified cohort model. This procedure begins with projections of basic employment levels (mining, manufacturing, ect.) and on the basis of these levels, estimates the corresponding level of non-basic employment, i.e., service, trade and government. Total employment is then converted to the level of population consistent with the employment projection.

Before explaining the details of the approach, it is important to understand the distinction between basic and nonbasic employment levels. Basic sectors are defined as those sectors whose level of economic activity is determined by forces outside the area of interest. These sectors are primarily those that export products outside the area and hence bring income into the region. On the other hand, nonbasic sectors serve local needs.

In the case of Lincoln County, the following sectors were classified as basic industries: Agriculture, Mining, Wood Products Manufacturing, Other Manufacturing, Railroad Transportation, Federal Government, and Heavy Construction Contractors working on major projects. Classification was based on detailed data available to the Research and Information Systems Division, Montana Department of Community Affairs. The remaining economic sectors were assumed to be non-basic, i.e., primarily serving local needs. The non-basic sectors included: Wholesale-Retail Trade; Finance, Insurance and Real Estate; (Private) Services; State/Local Government; Construction Contractors other than those working on major projects; Transportation (excluding railroad), Communications, and Utilities.

An example using the combined economic and modified cohort model to estimate changes in employment and population will illustrate how the technique works. From 1970 to 1974, basic employment in Lincoln County, including construction on the Libby Dam, declined by 962 employees. In order to estimate the population loss associated with this decline, a change in non-basic employment is first computed. Given a decline in basic employment between 1970-74, one would expect a decline in non-basic workers. The economic model being used in its simplest form postulates that non-basic employment changes are totally related to changes in basic activity. However, between 1970-1974 non-basic employment actually increased by 304 employees. This happened because temporary construction projects generally do not have a significant impact on non-basic employment, and because non-basic employment increased independently of basic employment between 1970 and 1974. This latter phenomenon was largely the result of a growing demand for services; an increased supply of workers, both male and female; and increased labor force participation by women. The same phenomenon was also experienced at the state and national levels during this period.

The method used to estimate non-basic employment and subsequently population, tries to account for the above mentioned factors. It distinguishes between temporary basic and permanent basic employment. Temporary employment is defined as that associated with the Libby Dam project in this case. Permanent basic employment is all other basic and is associated with economic activity of a more long-term nature. Non-basic employment and population estimates are computed separately for temporary and permanent basic figures and then combined into an estimate of total non-basic employment and population.

For the effects associated with a decline in construction employment related to the Libby Dam, non-basic employment is assumed not to change because of the insignificant impact of construction projects on service employment. The population loss associated with the Dam is simply computed by multiplying the average family size for construction workers (2.28)1/ times the decline in construction employment, i.e., 2.28 times 840 or 1915 people.

In order to estimate the population loss associated with the decline in permanent basic sectors, two multipliers are used. One is what may be called a non-basic employment multiplier which is simply the relative number of non-basic workers to permanent basic workers. The other is a population multiplier defined as the ratio of estimated natural increase population to the estimated employed labor force, calculated using a modified cohort model.

A projected 1974 non-basic multiplier is first used to estimate 1974 non-basic employment. This projected multiplier of 1.26 is the 1970 ratio of non-basic employment to permanent basic adjusted for changed in the labor force relative to the 1970 base. The adjustment procedure is used to try to account for changes in non-basic activity that are independent of basic employment levels. The specific changes in the labor force are calculated from a modified cohort model that survives the labor force yearly, using age and sex specific survival rates and changes in national age/sex specific labor force participation rates. The estimated 1974 non-basic employment is as follows:

2525	*	1.26	=	3181
1974 permanent basic employment		projected non-basic multiplier		estimated 1974 non-basic employment

The simulated non-basic employment level compares quite favorably to the actual level of 3170. The percentage error is only about three-tenths of one percent.

To simulate the total permanent employment level (excluding temporary construction), permanent basic and non-basic employment are summed as follows:

2525	+	3181	=	5706
Permanent basic		non-basic		permanent employment

1/ Average family size is taken from the Construction Worker Profile, Old West Commission, Rapid City, South Dekota, 1976.

This total permanent employment level (5706) is then converted to a corresponding population level by a population multiplier, or the ratio of projected 1974 natural increase population to projected 1974 employed labor force (calculated using a modified cohort model). The computation of 1974 permanent employment related population is:

5796	*	2.73	=	15,578
1974 permanent employment		population multiplier		1974 permanent population

The total decline in population since 1970 for Lincoln County can now be estimated. It is the combination of a decline in population associated with construction employment, and a change in population related to permanent employment. The former was computed previously as a decrese of 1915 people. The latter is computed by comparing the 1974 permanent employment related population (1,578) with a similar 1970 figure of 14,942. This translates into an increase of 636 people associated with permanent employment opportunities. Therefore, the net population change is a minus 1279 people. In summary, the 1974 estimated population is computed as follows:

(18,063)	-	(1915)	+	(15,578	-	14,942)	=	16,784
1970 actual level		construction population loss		1974 permanent population		1970 permanent population		1974 estimated population

In order for the technique to work in the future, it is necessary to know with some reliablity the level of future basic and temporary construction employment. If the employment projections are in serious error, the population projections will be also.

APPENDIX V

Department of Natural Resources and Conservation Analysis of Aesthetics Resource and the Proposed Transmission Line

EVALUATION OF THE VISUAL SETTING
OF THE PROPOSED
TROY-ASARCO 115 KV TRANSMISSION LINE

by

Larry Nordell and Ray Breuninger

Submitted to Department of State Lands
March 16, 1978

INTRODUCTION

In November, 1977, and in early March, 1978, a total of six man-days were spent in the field observing the visual setting of the proposed route, which in part follows existing 12.5 kV distribution line in the Lake Creek drainage. Discussions with U.S. Forest Service personnel in Libby, examination of visual evaluations contained in Forest Service land management plans, and examination of aerial photographs in November, 1977, provided additional information.

In evaluating the visual impact of a power line one must consider a variety of factors including the visual cahracteristics of the area traversed, the location of the poles and conductors with respect to the visual field, the size and construction of the line, and the expectations of the viewer. Greater impacts will tend to be associated, for example, with grander views, with a line passing directly between a viewer and the center of attention, with larger and more conspicuous lines, and with lines located in areas where they are not expected. Conversely, lesser impacts would be associated with lines in areas of little or no visual interest, with a line out of the way of the center of viewing interest, with smaller wood pole distribution lines, or with lines located where a viewer expects to find them, for example, near centers of human residential or industrial activity.

The proposed line from the Troy substation to the proposed Asarco Mt. Vernon mine and concentrator would involve upgrading an existing distribution line for the first 10 miles of its length. In the rebuilt portion the existing line would generally be replaced by single pole wooden structrues with a 115 kV superstructure and a 24.9 kV underbuild. The poles would be higher than the existing ones and carry more conductors. In evaluating the visual impacts of the proposed line attempt was made to visualize the taller structures and high conductors.

In general the existing line has low visual impact. For most of the distance along the Lake Creek Road, the line is backed by trees and is inconspicuous. Since the rebuilt line is proposed to follow the existing line route and be of similar design, its visual impact would be similarly low. However, in some places along the road there are open views in which both the existing line and the proposed rebuilt line obstruct scenic views from the road. In some of these locations the line is so close to the road that a viewer looks under it, and again the line is inconspicuous. At other locations along the road, the line is within a field of view containing strongly attractive visual elements. In these instances one must distinguish between views where the line is in sight but away from (usually below) the center of attention, and views where the line crosses immediately between the viewer and the center of attention. In the former case the impact is deemed moderate, in the latter case it is deemed high. The desirability of mitigative measures such as rerouting the line depends on the comparison of the additional costs associated with rerouting at the time of the reconstruction of the line, and the severity of the visual impacts to be mitigated. These points are discussed in greater detail below in the narrative description of the proposed route.

NARRATIVE DESCRIPTION OF THE PROPOSED ROUTE

This section contains a description of the terrain and visual setting of the proposed line along Northern Light's preferred and alternate routes. The narrative proceeds as if a viewer were driving south along the routes, but views from the opposite direction or from points off the road are also presented. The routes are divided into segments which are numbered and keyed to the maps (Figures 1A, 1B, and 1C). Problem areas are lettered, keyed to the map, and described in the concluding section of this report.

Segment I. Troy Substation

The substation is partially screened from view from U.S. Highway 2, which passes a few meters south of it (Problem Area A).

Segment II. Troy Substation to Intersection with Lake Creek Road

The existing line passes through dense second-growth timber growing on a flat, abandoned river terrace, and then drops down past several inactive gravel quarries to the small Troy Reservoir on Lake Creek. The line closely parallels a dirt road and is backed by trees except where it passes the gravel pits. There, the line is partially backed by trees, and partially skylined against a view of the Cabinet Range in the background to the southeast (Problem Area B).

Segment III. Lake Creek Road

The existing line closely follows Lake Creek road, which passes through second-growth forest and small open meadows along the east side of the Lake Creek bottomland. The line is skylined along a short stretch where it crosses from the west side of the highway to the east, but is visually absorbed by either a backing or a screening of trees in the forested sections. At open fields in the northeast corner of Section 30, T31N, R33W, the line blocks a view to the southeast of the Cabinet Range (Problem Area C).

Segment IV. Lake Creek Road (Continued)

The line passes across a series of bottomland meadows with patchy clumps of bushes and trees. The vegetation screens or backs the line throughout most of this area, but at Problem Areas D, E, and F the line interfers with views from the road. At D, the line is skylined where it crosses to the west side of the road. At E, the line is close to the road and a pleasant view is seen below the conductor wires southwestward to Lake Creek and the low, forested Freeman Ridge beyond. At F, the line crosses a meadow west of the road and impinges on a scenic roadside view of a grove of trees, with bottomland and Freeman Ridge in the background.

Segment V. Lake Creek road (Continued)

The existing line cuts southeastward from the road to service three houses. Through this half-kilometer section, the line is backed by trees and does not stand out in the scene. The line enters dense timber and diagonals southwestward for another half-kilometer, rejoining Lake Creek road after crossing Lake Creek. The trees effectively screen the line from view of the road except where the line is skylined at two places where it crosses the road. These road crossings are Problem Areas G and H.

Segment VI. Lake Creek Road (Continued)

The line parallels the road, crossing from the east side to west side several times. For the most part, the line is screened or backed by trees. However, at Problem Area I, the existing line interfers directly with scenic views of the Cabinet Range to the east and southeast, looking from the road out across recent clearcuts. At Problem Area J, there is a tunnel view to the southwest along the right-of-way, as viewed from the road. Complete clearing of trees along the straight right-of-way has made a narrow visual pathway, or tunnel view, bordered by tall trees which restrict the view.

Segment VII. NW Corner of Crowell Mtn. Quad to Junction with Highway 202

The line is on the east side of the road, and is backed by trees. About 300 m. north of Copper Creek there is a scenic view to the south-southeast along the road; the line does not interfere. At the Copper Creek crossing the line is skylined, and the view under the line to the east includes Dome Mountain. About 300 m. south of Copper Creek another view of Dome Mountain is blocked by the line (Problem Area K). The line crosses the road just north of the south end of the clearing, runs west of the road and is screened by trees, until it again crosses the road near the southeast corner of Section 18. At this point Problem area L), there is a tunnel view along the line toward the southeast. From there the line heads southeast, crossing Lake Creek and Twin Creek, to its junction with U.S. Highway 202. No road crosses Lake Creek in this vicinity.

The line passes over a ranch on Lake Creek, and conspicuously crosses a large clearing and the ranch buildings, and crosses the center of a spectacular view of the Cabinet Range and to the Lake Creek, east from the ranch access road. (Problem Area M).

Segment VIII. Junction with Highway 202 to End of Rebuild

For about 3/4 km, the line parallels the highway on the west side, and is screened by timber. It then comes into view of the road, but is backed by the forest. Another 1/3 km is screened from view by trees. The line crosses the highway in the southeast 1/4 of Section 29 and then parallels the highway on the east side, backed by the forest for almost 1 km until the settlement of Little Joe. At this point the line crosses the road, blocking a scenic view (to the south-southwest) of the steep slopes and cliffs rising above the west shore of Bull Lake (Problem area N). South from there the line proceeds on the west side of the road, and is backed by trees to the point where the rebuild will end and the line will head west. The distribution line continues south, along the west side of the road.

Segment IX. Camp Creek, Lake Creek Bottomland, and Lower Stanley Creek

The proposed route follows the existing and proposed roads through dense timber from U.S. Highway 202 southwest to and along the north side of Stanley Creek. It then veers south, crosses Stanley Creek and roughly parallels the road to the base of the switchbacks in Section 24, T29N, R34W. (See Problem Area O).

Segment X. Upper Stanley Creek

From the base of the switchbacks on the road in Section 24, T29N, R34W, the proposed route diagonally ascends the steep, clearcut hillslope, repeatedly crossing the switchbacks. It again closely parallels the road through dense timber on hummocky ground to the ASARCO plant site. The crossing of the switckbacks and clearcut is unavoidable without significantly increased expense and construction difficulty.

RECOMMENDATIONS FOR CENTERLINE CHANGES AT PROBLEM AREAS

Problem Area A

U.S. Highway 2 passes the Troy substation.

Recommendation. Additional plantings of trees and shrubs should be made between the road and station to more completely screen the station from view.

Problem Area B

The dirt road leading past the gravel pits to Lake Creek road receives minimal traffic. Most visitors will have their attention focused on the reservoir and thus the degredation of the view of the Cabinet Range by the line will not generally be noticeable.

Recommendation. No rerouting is needed.

Problem Area C

If moved to the west side of the road to mitigate the blockage of the view, the line would degrade an equally pleasant view across the bottomlands of Lake Creek.

Recommendation. No change in route is recommended unless the landowners desire it.

Problem Area D

If the route continued south along the east side of the road rather than crossing to the west, the line would pass closely to several residences rather than one residence on the west side. Also, the line would be lengthened slightly, and an area of slumps, i.e. unstable ground, would be crossed along the foot or slopes of the escarpment which bounds the east edge of the Lake Creek bottomland.

Recommendation. No rerouting should occur.

Problem Area E

The visual impact of the line on the view to the southwest is moderate, because the view is directed below the lines. Active slumps are on the steep slope immediately east of the road.

Recommendation. No rerouting change is recommended.

Problem Area F

A shift of the line from the middle of the meadow eastward to the edge of the road would significantly improve the view from the road because the view would be directed below the lines.

Recommendation. This reroute is recommended.

Problem Area G and H

Tunnel views result when looking southwest from the road at G, and northeast from the road at H.

Recommendation. These tunnel views along the right-of-way should be screened with judicious plantings of shrubs and bushes.

Problem Area I

The visual impact of the line will be significant until trees regrow on the clearcuts. The line could be moved to the west side of the road in this area unless the residents or owner of the residence in the extreme southeast quarter of section 6, T30N, R33W object. This residence would be closely passed by the relocated line. Considerable timber clearing would be needed along the reroute; most of this area has been or may be logged in any case.

Recommendation. Contact the landowners, then make decision on the reroute.

Problem Area J

The tunnel view would be somewhat improved by planting a screen of bushes and shrubs.

Recommendation. Make plantings to eliminate the tunnel-effect.

Problem Area K

The road swings around the west and southwest of a large clearing, and then continues towards the south-southeast. A spectacular view towards Dome Mountain and the crest of the Cabinet range is crossed by the line at a moderately low level in the field of view. The taller poles and additional conductors on the rebuilt line will increase the degree to which the viewer is distracted.

Recommendation. By relocating the line alongside the road, preferably to the west side of the road the visual impact would be essentially eliminated. Since the existing line impacts would be removed there would be a net benefit to offset the cost of the slight increase in length.

Problem Area L

At the intersection in Section 18 near the southeast corner, just north of the Keeler Creek crossing, the line crosses the road, heading southeast. The viewer at this point sees the linear tunnel effect of a clearcut for over 1 km along the right-of-way.

Recommendation. Putting a bend in the line between the intersection and the ranch in Section 20 would eliminate this problem. See recommendation for problem area M.

Problem Area M

The approach road to the ranch enters the clearing from the west. The existing line enters from the west-northwest and proceeds east-southeast diagonally across the clearing. Upon entering the clearing the existing line conspicuously detracts from the spectacular view across to the east.

Recommendation. By rerouting the line so that it crosses the road in a north-south direction west of the clearing, and then skirts the clearing to the south, the visual impacts could be mitigated at the cost of a longer line and more timber clearing. The desires of the residents of the ranch should be considered in any reroute decision.

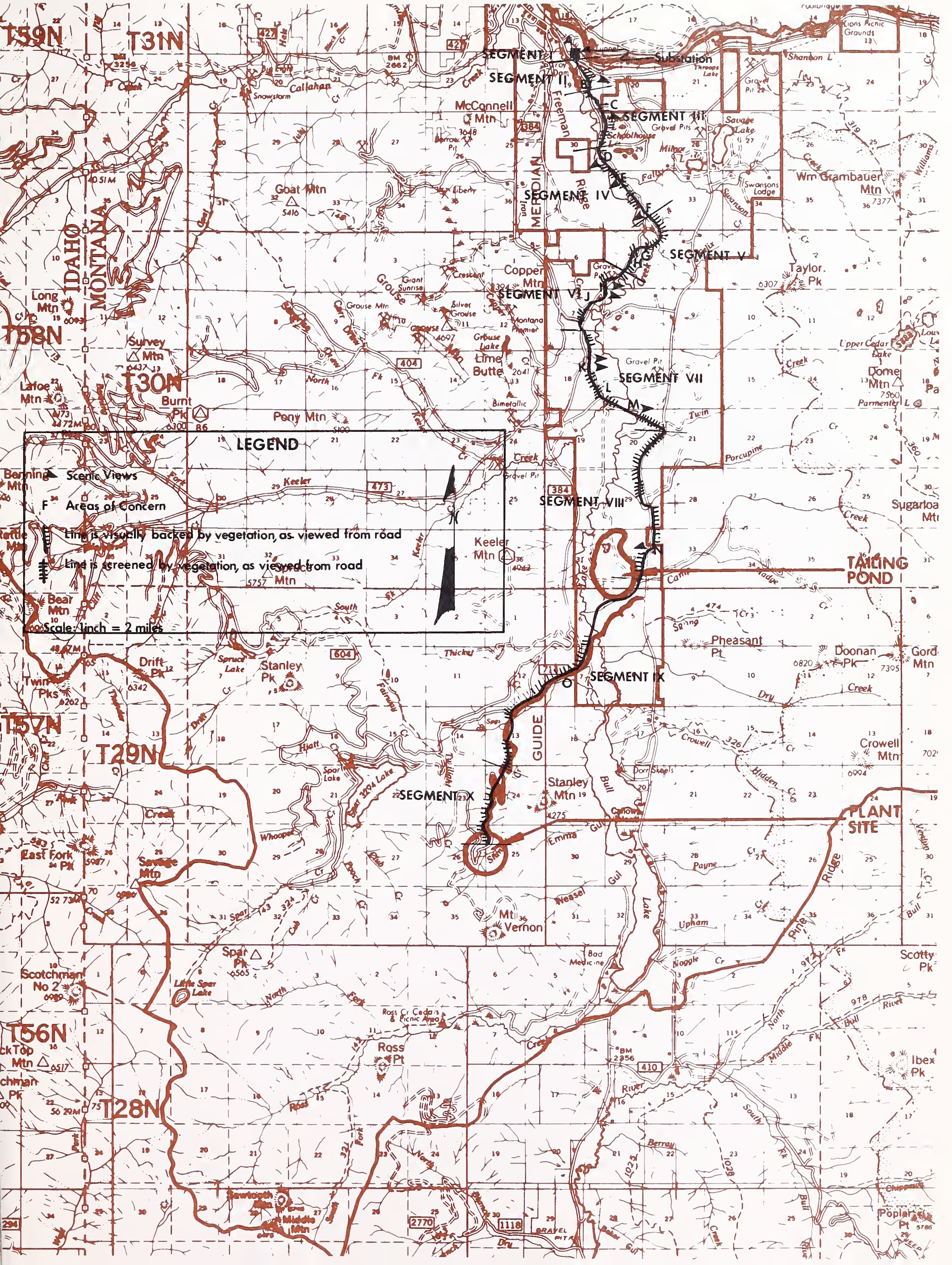
Problem Area N

North of Little Joe the line is on the east side of the road, backed by the trees. At Little Joe the line crosses the road in a northeast-southwest direction. At this point the viewer looking south-southwest sees a striking view of the steep slopes west of Bull Lake. The line passes directly across the field of view.

Recommendation. The proposed line could be relocated to continue south on the east side of the road another 2/3 km, and then cross the road at a right angle at the point the new line diverges from the distribution line. At this point the trees block the above-mentioned view and the line crossing here would have little impact.

Problem Area O. This is a densely timbered area between U.S. Highway 202 and the switchbacks at Stanley Creek. If the line were built immediately adjacent to the road, the clearing of timber would be minimized--a considerable advantage. The line would, however, be in full view from the road, which would have frequent mostly non-recreational traffic to and from the mine. If the line were built north and west of the road, it would be screened by a narrow belt of uncut trees. This reroute would also eliminate the possibility of vehicular collisions with the line poles. Countering these arguments, problems with inspection and access for repairs would be increased.

Recommendation. Information about timber and wildlife resources should be assessed prior to a choice between the two alternative centerlines.


LEGEND
Scenic Views
F Areas of Concern
Line is visually backed by vegetation, as viewed from road
Line is screened by vegetation, as viewed from road
Scale: 1 inch = 2 miles
SEGMENT I
SEGMENT II
SEGMENT III
SEGMENT IV
SEGMENT V
SEGMENT VI
SEGMENT VII
SEGMENT VIII
SEGMENT IX
SEGMENT X
TAILING POND
PLANT SITE
Substation
T59N
T31N
T58N
T30N
T57N
T29N
T56N
T28N
IDAHO
MONTANA
MERIDIAN
GUIDE
McConnell Mtn
Goat Mtn
Copper Mtn
Lime Butte
Pony Mtn
Keeler Mtn
Stanley Pk
Stanley Mtn
Mt Vernon
Spar Pk
Ross Pt
Taylor Pk
Wm Grambauer Mtn
Dome Mtn
Pheasant Pt
Doonan Pk
Crowell Mtn
Savage Lake
Swansons Lodge
Gravel Pits

APPENDIX W

Department of Natural Resources and Conservation Analysis of Geology, Soils, and Hydrology Resources and the Proposed Transmission Line

REPORT TO DEPARTMENT OF STATE LANDS

EVALUATION OF THE PROPOSED TROY -- ASARCO 115 KV TRANSMISSION LINE, GEOLOGY, SOILS, HYDROLOGY

Two days in the field were spent observing the surface geology and hydrology in the Lake Creek and Stanley Creek drainages along the proposed route of the transmission line. Also during this period, aerial photos of the area were examined in the U.S. Forest Service office in Libby, and cross-checked against field relationships. Library research was done in Helena.

The following observations and conclusions were reached regarding geologic hazards along the proposed centerline:

(1) Unstable Ground

The existing 12.5 kV line transmission line crosses an area of small slumps in glacio-lacustrine silt and clay beds in the east ½ of section 30, T31N, R33W (Figure 1). There, the line climbs to near the top of a steep roadcut in a bluff on the east side of the Lake Creek road, 0.9 miles south of the intersection with U.S. Highway 2 . According to W.C. Alden (in Gibson, R., 1948, p. 59) above the road in this cut are exposed about 115 feet of fine-grained lake silt, overlain by about 15 feet of coarse-grained, partly cemented gravel, which is overlain by 30 feet or more of sand and fine-grained silt.

The transmission line pole at the north end of the road cut is tilted to the east; the pole probably rides on an active rotational slump block that is moving down and to the west. The pole at the south end of the road cut is tilted slightly off vertical.

Examination of similar deposits of lake silt and clay exposed at four other sites in the northern five miles of Lake Creek valley shows that approximately the upper six feet of lake silt beds consistently contains slumps ON SLOPES of about 15 degrees or more, whether or not the slope has been undercut by road construction.

There is no room to place the new line farther to the west, between the road and Lake Creek, on the segment of the route which is subject to slumping.

Recommendation: The route of the line should be moved eastward, to avoid the steep, unstable area of the road cut. Where the line ascends the bluff to reach the flat terrace above, if possible a long span should be used to avoid placing towers on the slope, which is subject to slumping even where it is not made more unstable by road excavation. Similar precautions should be taken farther south where the line descends back across the scarp and to the alluvial valley floor again. Poles should not be placed at the very edge of the slope, if possible. If necessary to place poles on unstable ground, they should be inspected regularly for signs of movement. Deep, solid pole foundations might slow or stop slump movement on gentle slopes: but would probably be ineffective on slopes such as occur in section 8.

(2) Possible unstable ground

Farther south, in the NE ¼ of section 20, T30N, R33W, the proposed route passes across a slope which is presumed to be underlain in its lower part by lake silt and clay deposits that may be subject to slumping (Figure 2). This site is inferred from topography as seen on aerial photos and topographic map, but was not examined in the field. The slope is not as steep as the one described in (1), but is cut by a small intermittent stream which locally may introduce water to the sediment and make it more unstable.

Recommendation: When planning pole sites in this area, close attention should be paid to site stability. If evidence of slumping is seen (hummocky ground, discolored joints in the subsoil, tilted trees or poles, amphitheater-shaped hollows above possible slump masses), then rerouting or modified construction practices should be considered.

(3) Impact of Line on View of Cabinent Range

At several places in sections 5, 7, 8, and 18, T30N, R33W, the proposed route of the line runs along the east side of Lake Creek Road. Considering the existing line, the view of the Cabinent Range to the east is not badly obscured where the line is close to the road, because the wires are above the field of vision. However, in the NE ¼ of section 18, the existing line is well away from the road. It passes near a house and south into a large open field. The present line slightly degrades the view of the mountains beyond; and the larger proposed line would have significantly greater visual impact.

Recommendation: The line could be relocated westward and placed either just west or just east of the road, preferably to the west. A slight increase in the length and cost of the line would result.

If it could be done with little cost, and with landowner approval, it would be best to locate the line west of the road throughout most of the sections 5, 7, 8 and 18, to improve the view to the east. This should not be done where the line would pass near existing residences.

(4) Alternate Route in Spar Lake -- Stanley Creek Area

Reconnaissance field examination of the Stanley Creek and Spar Lake areas, plus examination of topographic maps and aerial photos, suggests that the tailings thickner and office site is located on a kame terrace (ice-margin terrace) that was deposited along the sides and at the upper end of an arm of the continental glacier which flowed southward down the valley of Lake Creek. The terrace sediments were not deposited as the terminal moraine of the small alpine glacier that formerly headed above the mill site in Stanley Creek. Caught between the ice of the continental glacier and the valley wall, meltwater from the Spar Lake area probably flowed along a kame terrace (which is today seen as the well-defined bench at an elevation of about 3400-3500 feet in sections 23 and 24, T29N, R23W) and into the area of the office site in the Stanley Creek drainage. From there, the meltwater intermittently escaped to the Lake Creek -- Bull River valley via Emma Gulch. The rapid fluctuations in the level of water of Spar Lake are explained by the ready drainage of water through the relatively porous, stratified sand and gravel which were deposited as a kame terrace dam across the Spar Lake valley.

Recommendation: No problems are foreseen with power line construction along the proposed route. If the alternate route is followed toward Spar Lake, then back along an ascending traverse of the mountainside, care should be taken to check tower foundations in sections 23 and 24, where the proposed alternate road and line would be in steep, unconsolidated sediments on the outer slope of the kame terrace. The kame terrace is probably composed mainly of poor-to well-sorted, stratified sand and gravel, with irregular lenses of very poorly sorted glacial till on the outer slope of the terrace.

APPENDIX X

National Forest Surface Use Under U.S. Mining Laws

(36 CFR. 252.1 - 252.15)

federal register

NATIONAL FOREST MINERAL RESOURCES—USDA rules on prospecting, exploration and mining procedures; effective 9-1-74

Title 36—Parks, Forests, and Public Property

CHAPTER II—FOREST SERVICE, DEPARTMENT OF AGRICULTURE

NATIONAL FORESTS SURFACE USE UNDER U.S. MINING LAWS

Regulations are hereby adopted concerning the use of the surface of National Forest System lands by persons operating under the United States mining laws of 1872, as amended. Parts 251 and 293 are amended and a new Part 252 is added.

The public was afforded an opportunity to comment on proposed rulemaking published on December 19, 1973 (38 FR 34817) and on July 16, 1974 (39 FR 26038). Respondents included Government agencies (National, State, and local), conservation organizations, mining associations, United States Senators and Congressmen, and individuals directly or indirectly concerned with mineral operations. The proposed regulations were also the subject of oversight hearings by the Public Lands Subcommittee of the Committee on Interior and Insular Affairs of the House of Representatives.

Comments ranged from total opposition to unqualified support of the proposals. Critical comments were in the majority. Many persons suggested changes or improvements in both wording and substance.

Although many respondents objected to the operating plan requirement, the essence of adequate regulation is development of operating plans which reflect both the necessities for environmental protection and for the use of surface resources in connection with mineral operations. A provision for operating plans is part of the regulations.

A major concern expressed by the mining industry, and noted by the Public Lands Subcommittee of the House Committee on Interior and Insular Affairs, is the possibility of unreasonable enforcement of the regulations, with resulting cost increases that could make otherwise viable mineral operations prohibitively expensive. The Forest Service recognizes that prospectors and miners have a statutory right, not mere privilege, under the 1872 mining law and the Act of June 4, 1897, to go upon and use the open public domain lands of the National Forest System for the purposes of mineral exploration, development and production. Exercise of that right may not be unreasonably restricted. Specific provision has been made in the operating plan approval section of the regulations charging Forest Service administrators with the responsibility to consider the economics of operations, along with the other factors, in determining the reasonableness of the requirements for surface resource protection.

Many comments objected to the time provided for Forest Service response to proposed operating plans. No change has been made in these provisions since the time allowances are reasonable as outside limits. Even so, Forest Service administrators are expected to process operating plans promptly with the objective of responding, on the average, in half of the time allowed.

The requirement for a minimum bond of $2,000 for any activities subject to operating plans was the provision most heavily criticized. Many respondents pointed to the discriminatory effect and negative impact on small miners and prospectors having relatively limited means. The bond provision has been changed to reduce discriminatory effects and to be more specific as to coverage, but remain responsive to the need to maintain the responsibilities of operators for reclamation and mitigation of the effects of surface disturbing operations.

Some respondents felt that all information and data submitted on proposed operations should be subject to full public disclosure. The rule of reasonableness is particularly applicable since proprietary data and competitive rights are involved. The section on availability of information to the public recognizes these factors.

Language has been modified to make more clear that the intent of these regulations is protection of the surface resources on National Forest System lands.

A number of comments noted the lack of a provision for a "notice of intent to operate." Such a provision has been included in the regulations.

The provision concerning data to be furnished in an operating plan has been simplified and is clarified to state that the Forest Service, rather than the operator, has the responsibility for analyzing the environmental impacts that may be expected from proposed operations.

Many respondents criticized the language about environmental impact statements and appeals procedures. Those sections have been clarified. The number of levels of appeal provided is small in order to allow aggrieved parties quick access to the courts to seek redress.

Seasonal factors in most of the western mountains preclude prospecting and exploration during winter and early spring. A 120-day grace period is provided within which to file required operating plans in the case of operations underway on the effective date of the regulations. Under the circumstances, the regulations should not have significant effect on ongoing operations during the remainder of this operating season.

A Final Environmental Statement, prepared in accordance with section 102(2)(c) of the National Environmental Policy Act of January 1, 1970 (42 U.S.C. 4332(2)(C)), was filed with the Council on Environmental Quality on July 16, 1974. The statement discussed the environmental impact of issuing the regulations as proposed.

Reprinted from

The regulations will be effective September 1, 1974.

The amendment of Chapter II follows:

PART 251—LAND USES

§ 251.12 [Revoked]

1. Part 251 is amended by revoking § 251.12.

PART 252—MINERALS

2. A new Part 252 is added to read as follows:

Sec.
252.1 Purpose.
252.2 Scope.
252.3 Definitions.
252.4 Plan of operations—notice of intent—requirements.
252.5 Plan of operations—approval.
252.6 Availability of information to the public.
252.7 Inspection, noncompliance.
252.8 Requirements for environmental protection.
252.9 Maintenance during operations, public safety.
252.10 Cessation of operations, removal of structures and equipment.
252.11 Prevention and control of fire.
252.12 Access.
252.13 Bonds.
252.14 Appeals.
252.15 Operations within National Forest Wilderness.

AUTHORITY: 30 Stat. 35 and 36, as amended (16 U.S.C. 478, 551), unless otherwise noted.

§ 252.1 Purpose.

It is the purpose of these regulations to set forth rules and procedures through which use of the surface of National Forest System lands in connection with operations authorized by the United States mining laws (30 U.S.C. 21–54), which confer a statutory right to enter upon the public lands to search for minerals, shall be conducted so as to minimize adverse environmental impacts on National Forest System surface resources. It is not the purpose of these regulations to provide for the management of mineral resources; the responsibility for managing such resources is in the Secretary of the Interior.

§ 252.2 Scope.

These regulations apply to operations hereafter conducted under the United States mining laws of May 10, 1872, as amended (30 U.S.C. 22 et seq.), as they affect surface resources on all National Forest System lands under the jurisdiction of the Secretary of Agriculture to which such laws are applicable: *Provided, however;* That any area of National Forest lands covered by a special Act of Congress (16 U.S.C. 482a–482q) is subject to the provisions of this part and the provisions of the special act, and in the case of conflict the provisions of the special act shall apply.

§ 252.3 Definitions.

For the purposes of this part the following terms, respectively, shall mean

(a) *Operations.* All functions, work and activities in connection with prospecting, exploration, development, mining or processing of mineral resources and all uses reasonably incident thereto, including roads and other means of access on lands subject to the regulations in this part, regardless of whether said operations take place on or off mining claims.

(b) *Operator.* A person conducting or proposing to conduct operations.

(c) *Person.* Any individual, partnership, corporation, association, or other legal entity.

(d) *Mining claim.* Any unpatented mining claim or unpatented millsite authorized by the United States mining laws of May 10, 1872, as amended (30 U.S.C. 22 et seq.).

(e) *Authorized officer.* The Forest Service officer to whom authority to review and approve operating plans has been delegated

§ 252.4 Plan of Operations—Notice of Intent—Requirements.

(a) Except as provided in paragraph (2) of this section, a notice of intention to operate is required from any person proposing to conduct operations which might cause disturbance of surface resources. Such notice of intention shall be submitted to the District Ranger having jurisdiction over the area in which the operations will be conducted. If the District Ranger determines that such operations will likely cause significant disturbance of surface resources, the operator shall submit a proposed plan of operations to the District Ranger.

(1) The requirements to submit a plan of operations shall not apply (i) to operations which will be limited to the use of vehicles on existing public roads or roads used and maintained for National Forest purposes, (ii) to individuals desiring to search for and occasionally remove small mineral samples or specimens, (iii) to prospecting and sampling which will not cause significant surface resource disturbance and will not involve removal of more than a reasonable amount of mineral deposit for analysis and study, (iv) to marking and monumenting a mining claim and (v) to subsurface operations which will not cause significant surface resource disturbance.

(2) A notice of intent need not be filed (i) where a plan of operations is submitted for approval in lieu thereof, (ii) for operations excepted in paragraph (1) of this section from the requirement to file a plan of operations, (iii) for operations which will not involve the use of mechanized earthmoving equipment such as bulldozers or backhoes and will not involve the cutting of trees. Each notice of intent to operate shall provide information sufficient to identify the area involved, the nature of the proposed operations, the route of access to the area of operations and the method of transport. If a notice of intent is filed, the District Ranger will, within 15 days of receipt thereof, notify the operator whether a plan of operations is required.

(b) Any person conducting operations on the effective date of these regulations, who would have been required to submit a plan of operations under § 252.4 (a), may continue operations but shall within 120 days thereafter submit a plan of operations to the District Ranger having jurisdiction over the area within which operations are being conducted: *Provided, however,* That upon a showing of good cause the authorized officer will grant an extension of time for submission of a plan of operations, not to exceed an additional 6 months. Operations may continue according to the submitted plan during its review, unless the authorized officer determines that the operations are unnecessarily or unreasonably causing irreparable damage to surface resources and advises the operator of those measures needed to avoid such damage. Upon approval of a plan of operations, operations shall be conducted in accordance with the approved plan. The requirement to submit a plan of operations shall not apply (1) to operations excepted in § 252.4(a) or (2) to operations concluded prior to the effective date of the regulations in this part.

(c) The plan of operations shall include:

(1) The name and legal mailing address of the operators (and claimants if they are not the operators) and their lessees, assigns, or designees.

(2) A map or sketch showing information sufficient to locate the proposed area of operations on the ground, existing and/or proposed roads or access routes to be used in connection with the operations as set forth in § 252.12 and the approximate location and size of areas where surface resources will be disturbed.

(3) Information sufficient to describe or identify the type of operations proposed and how they would be conducted, the type and standard of existing and proposed roads or access routes, the means of transportation used or to be used as set forth in § 252.12, the period during which the proposed activity will take place, and measures to be taken to meet the requirements for environmental protection in § 252.8.

(d) The plan of operations shall cover the requirements set forth in paragraph (c) of this section, as foreseen for the entire operation for the full estimated period of activity: *Provided, however,* That if the development of a plan for an entire operation is not possible at the time of preparation of a plan, the operator shall file an initial plan setting forth his proposed operation to the degree reasonably foreseeable at that time, and shall thereafter file a supplemental plan or plans whenever it is proposed to undertake any significant surface disturbance not covered by the initial plan.

(e) At any time during operations under an approved plan of operations, the authorized officer may ask the operator to furnish a proposed modification of the plan detailing the means of minimizing unforeseen significant disturbance of surface resources. If the operator does not furnish a proposed modification within a time deemed reasonable by the authorized officer, the authorized officer may recommend to his immediate superior that the operator be required to submit a proposed modification of the plan. The recommendation of the authorized officer shall be accompanied by a statement setting forth in detail the supporting facts and reasons for his recommendations. In acting upon such recommendation, the immediate superior of the authorized officer shall determine (1) whether all reasonable measures were taken by the authorized officer to predict the environmental impacts of the proposed operations prior to approving the operating plan, (2) whether the disturbance is or probably will become of such significance as to require modification of the operating plan in order to meet the requirements for environmental protection specified in § 252.8 and (3) whether the disturbance can be minimized using reasonable means. Lacking such determination that unforeseen significant disturbance of surface resources is occurring or probable and that the disturbance can be minimized using reasonable means, no operator shall be required to submit a proposed modification of an approved plan of operations. Operations may continue in accordance with the approved plan until a modified plan is approved, unless the immediate superior of the authorized officer determines that the operations are unnecessarily or unreasonably causing irreparable injury, loss or damage to surface resources and advises the operator of those measures needed to avoid such damage.

(f) Upon completion of an environmental analysis in connection with each proposed operating plan, the authorized officer will determine whether an environmental statement is required. Not every plan of operations, supplemental plan or modification will involve the preparation of an environmental statement. Environmental impacts will vary substantially depending on whether the nature of operations is prospecting, exploration, development, or processing, and on the scope of operations (such as size of operations, contruction required, length of operations and equipment required), resulting in varying degrees of disturbance to vegetative resources, soil, water, air, or wildlife. The Forest Service will prepare any environmental statements that may be required.

§ 252.5 Plan of Operations—Approval.

(a) Operations shall be conducted in accordance with an approved plan of operations, except as provided in section (b) of this section and in § 252.4(a), (b), and (e). A proposed plan of operation shall be submitted to the District Ranger, who shall promptly acknowledge receipt thereof to the operator. The authorized officer shall, within thirty (30) days of such receipt, analyze the proposal, considering the economics of the operation along with the other factors in determining the reasonableness of the requirements for surface resource protection, and:

(1) Notify the operator that he has approved the plan of operations, or

(2) Notify the operator that the proposed operations are such as not to require an operating plan; or

(3) Notify the operator of any changes in, or additions to, the plan of operations deemed necessary to meet the purpose of the regulations in this part; or

(4) Notify the operator that the plan is being reviewed, but that more time, not to exceed an additional sixty (60) days, is necessary to complete such review, setting forth the reasons why additional time is needed: *Provided, however,* That days during which the area of operations is inaccessible for inspection shall not be included when computing the sixty (60) day period; or

(5) Notify the operator that the plan cannot be approved until a final environmental statement has been prepared and filed with the Council on Environmental Quality as provided in § 252.4(f).

(b) Pending final approval of the plan of operations, the authorized officer will approve such operations as may be necessary for timely compliance with the requirements of Federal and State laws, so long as such operations are conducted so as to minimize environmental impacts as prescribed by the authorized officer in accordance with the standards contained in § 252.8.

(c) A supplemental plan or plans of operations provided for in § 252.4(d) and a modification of an approved operating plan as provided for in § 252.4(e) shall be subject to approval by the authorized officer in the same manner as the initial plan of operations: *Provided, however,* That a modification of an approved plan of operations under § 252.4(e) shall be subject to approval by the immediate superior of the authorized officer in cases where it has been determined that a modification is required.

(d) In the provisions for review of operating plans, the Forest Service will arrange for consultation with appropriate agencies of the Department of the Interior with respect to significant technical questions concerning the character of unique geologic conditions and special exploration and development systems, techniques, and equipment, and with respect to mineral values, mineral resources, and mineral reserves. Further, the operator may request the Forest Service to arrange for similar consultations with appropriate agencies of the U.S. Department of the Interior for a review of operating plans.

§ 252.6 Availability of information to the public.

Except as provided herein, all information and data submitted by an operator pursuant to the regulations in this part shall be available for examination by the public at the Office of the District Ranger in accordance with the provisions of 7 CFR 1.1–1.6 and 36 CFR 200.5–200.10. Specifically identified information and data submitted by the operator as confidential concerning trade secrets or privileged commercial or financial information will not be available for public examination. Information and data to be withhold from public examination may include, but is not limited to, known or estimated outline of the mineral deposits and their location, attitude, extent, outcrops, and content, and the known or planned location of exploration pits, drill holes, excavations pertaining to location and entry pursuant to the United States mining laws, and other commercial information which relates to competitive rights of the operator.

§ 252.7 Inspection, noncompliance.

(a) Forest Officers shall periodically inspect operations to determine if the operator is complying with the regulations in this part and an approved plan of operations.

(b) If an operator fails to comply with the regulations or his approved plan of operations and the noncompliance is unnecessarily or unreasonably causing injury, loss or damage to surface resources the authorized officer shall serve a notice of noncompliance upon the operator or his agent in person or by certified mail. Such notice shall describe the noncompliance and shall specify the action to comply and the time within which such action is to be completed, generally not to exceed thirty (30) days: *Provided, however,* That days during which the area of operations is inaccessible shall not be included when computing the number of days allowed for compliance.

§ 252.8 Requirements for Environmental Protection.

All operations shall be conducted so as, where feasible, to minimize adverse environmental impacts on National Forest surface resources, including the following requirements:

(a) *Air Quality.* Operator shall comply with applicable Federal and State air quality standards, including the requirements of the Clean Air Act, as amended (42 U.S.C. 1857 et seq.).

(b) *Water Quality.* Operator shall comply with applicable Federal and State water quality standards, including regulations issued pursuant to the Federal Water Pollution Control Act, as amended (33 U.S.C. 1151 et seq.).

(c) *Solid Wastes.* Operartor shall comply with applicable Federal and State standards for the disposal and treatment of solid wastes. All garbage, refuse, or waste, shall either be removed from National Forest lands or disposed of or treated so as to minimize, so far as is practicable, its impact on the environment and the forest surface resources. All tailings, dumpage, deleterious materials or substances and other waste produced by operations shall be deployed, arranged, disposed of or treated so as to minimize adverse impact upon the environment and forest surface resources.

(d) *Scenic Values*. Operator shall, to the extent practicable, harmonize operations with scenic values through such measures as the design and location of operating facilities, including roads and other means of access, vegetative screening of operations, and construction of structures and improvements which blend with the landscape.

(e) *Fisheries and Wildlife Habitat*. In addition to compliance with water quality and solid waste disposal standards required by this section, operator shall take all practicable measures to maintain and protect fisheries and wildlife habitat which may be affected by the operations.

(f) *Roads*. Operator shall construct and maintain all roads so as to assure adequate drainage and to minimize or, where practicable, eliminate damage to soil, water, and other resource values. Unless otherwise approved by the authorized officer, roads no longer needed for operations (1) shall be closed to normal vehicular traffic, (2) bridges and culverts shall be removed, (3) cross drains, dips, or water bars shall be constructed, and (4) the road surface shall be shaped to as near a natural contour as practicable and be stabilized.

(g) *Reclamation*. Upon exhaustion of the mineral deposit or at the earliest practicable time during operations, or within 1 year of the conclusion of operations, unless a longer time is allowed by the authorized officer, operator shall, where practicable, reclaim the surface disturbed in operations by taking such measures as will prevent or control onsite and off-site damage to the environment and forest surface resources including:

(1) Control of erosion and landslides;

(2) Control of water runoff;

(3) Isolation, removal or control of toxic materials;

(4) Reshaping and revegetation of disturbed areas, where reasonably practicable; and

(5) Rehabilitation of fisheries and wildlife habitat.

(h) Certification or other approval issued by State agencies or other Federal agencies of compliance with laws and regulations relating to mining operations will be accepted as compliance with similar or parallel requirements of these regulations.

§ 252.9 Maintenance during operations, public safety.

During all operations operator shall maintain his structures, equipment, and other facilities in a safe, neat and workmanlike manner Hazardous sites or conditions resulting from operations shall be marked by signs, fenced or otherwise identified to protect the public in accordance with Federal and State laws and regulations.

§ 252.10 Cessation of operations, removal of structures and equipment.

Unless otherwise agreed to by the authorized officer, operator shall remove within a reasonable time following cessation of operations all structures, equipment and other facilities and clean up the site of operations. Other than seasonally, where operations have ceased temporarily, an operator shall file a statement with the District Ranger which includes (1) verification of intent to maintain the structures, equipment and other facilities, (2) the expected reopening date, and (3) an estimate of extended duration of operations. A statement shall be filed every year in the event operations are not reactivated. Operator shall maintain the operating site, structures, equipment and other facilities in a neat and safe condition during nonoperating periods.

§ 252.11 Prevention and control of fire.

Operator shall comply with all applicable Federal and State fire laws and regulations and shall take all reasonable measures to prevent and suppress fires on the area of operations and shall require his employees, contractors and subcontractors to do likewise.

§ 252.12 Access.

An operator is entitled to access in connection with operations, but no road, trail, bridge, landing area for aircraft, or the like, shall be constructed or improved, nor shall any other means of access, including but not limited to off-road vehicles, be used until the operator has received approval of an operating plan in writing from the authorized officer when required by § 252.4(a). Proposals for construction, improvement or use of such access as part of a plan of operations shall include a description of the type and standard of the proposed means of access, a map showing the proposed route of access, and a description of the means of transportation to be used. Approval of the means of such access as part of a plan of operations shall specify the location of the access route, design standards, means of transportation, and other conditions reasonably necessary to protect the environment and forest surface resources, including measures to protect scenic values and to insure against erosion and water or air pollution.

§ 252.13 Bonds.

(a) Any operator required to file a plan of operations shall, when required by the authorized officer, furnish a bond conditioned upon compliance with § 252 8(g), prior to approval of such plan of operations. In lieu of a bond, the operator may deposit into a Federal depository, as directed by the Forest Service, and maintain therein, cash in an amount equal to the required dollar amount of the bond or negotiable securities of the United States having market value at the time of deposit of not less than the required dollar amount of the bond. A blanket bond covering nationwide or statewide operations may be furnished if the terms and conditions thereof are sufficient to comply with the regulations in this part.

(b) In determining the amount of the bond, consideration will be given to the estimated cost of stabilizing, rehabilitating, and reclaiming the area of operations.

(c) In the event that an approved plan of operations is modified in accordance with § 252.4 [illegible]) and (e) of this part, the authorized officer will review the initial bond for adequacy and, if necessary, will adjust the bond to conform to the operations plan as modified.

(d) When reclamation has been completed in accordance with § 252.8(g), the authorized officer will notify the operator that performance under the bond has been completed: *Provided, however*, That when the Forest Service has accepted as completed any portion of the reclamation, the authorized officer shall notify the operator of such acceptance and reduce proportionally the amount of bond thereafter to be required with respect to the remaining reclamation.

§ 252.14 Appeals.

(a) Any operator aggrieved by a decision of the authorized officer in connection with the regulations in this part may file with the authorized officer a written statement setting forth in detail the respects in which the decision complained of is contrary to, or in conflict with, the facts, the law, or the regulations of the Secretary, or is otherwise in error. No such appeal will be considered unless it is filed with the authorized officer within thirty (30) days after the date of notification to the operator of the action or decision complained of. Upon receipt of appellant's statement, the authorized officer shall promptly prepare his own statement explaining his decision and the reasons therefor and forward the statements and record to his immediate superior for review and decision. The decision of the Regional Forester shall be the final administrative appeal decision.

(b) At the time appellant files his written statement of appeal he may request and shall be afforded an opportunity to present his views orally to the reviewing Forest Service officer.

(c) If the reviewing Forest Service officer considers the record inadequate to support a decision on the appeal, he may provide for the production of such additional evidence or information as may be appropriate or may remand the case with appropriate instructions for further action.

(d) The official files of the Forest Service relating to these appeals and any testimony and documents submitted by the parties on which the decision of the authorized officer was based constitute the record in the appeal. The authorized officer shall maintain the record under separate cover and shall certify that it is the record on which his decision was based at the time it is forwarded to his immediate superior for review. The Forest Service shall make the record available to the appellant upon request.

(e) On or before the expiration of forty-five (45) days after his receipt of the record the reviewing officer shall make his decision: *Provided, however,* That if more than forty-five (45) days are required for a decision after the record is received, the reviewing officer shall notify the parties to the appeal and specify the reason for delay. The decisions of reviewing officers shall include (1) a statement of facts, (2) conclusions, and (3) reasons upon which the conclusions are based.

(f) A decision of the authorized officer from which an appeal is taken shall not be automatically stayed by the filing of a statement of appeal. A request for a stay may accompany the statement of appeal or may be directed to the reviewing officer. The reviewing officer shall promptly rule on requests for stays. The decision of the Regional Forester on requests for stays shall constitute the final administrative appeal decision.

§ 252.15 Operations within national forest wilderness.

(a) The United States mining laws shall extend to each National Forest Wilderness for the period specified in the Wilderness Act and subsequent establishing legislation to the same extent they were applicable prior to the date the Wilderness was designated by Congress as a part of the National Wilderness Preservation System. Subject to valid existing rights, no person shall have any right or interest in or to any mineral deposits which may be discovered through prospecting or other information-gathering activity after the legal date on which the United States mining laws cease to apply to the specific Wilderness.

(b) Holders of unpatented mining claims validly established on any National Forest Wilderness prior to inclusion of such unit in the National Wilderness Preservation System shall be accorded the rights provided by the United States mining laws as then applicable to the National Forest land involved. Persons locating mining claims in any National Forest Wilderness on or after the date on which said Wilderness was included in the National Wilderness Preservation System shall be accorded the rights provided by the United States mining laws as applicable to the National Forest land involved and subject to provisions specified in the establishing legislation. Persons conducting operations as defined in § 252.3 in National Forest Wilderness shall comply with the regulations in this part. Operations shall be conducted so as to protect National Forest surface resources in accordance with the general purposes of maintaining the National Wilderness Preservation System unimpaired for future use and enjoyment as wilderness and to preserve its wilderness character, consistent with the use of the land for mineral location, exploration, development, drilling, and production and for transmission lines, water lines, telephone lines, and processing operations, including, where essential, the use of mechanized transport, aircraft or motorized equipment.

(c) Persons with valid mining claims wholly within National Forest Wilderness shall be permitted access to such surrounded claims by means consistent with the preservation of National Forest Wilderness which have been or are being customarily used with respect to other such claims surrounded by National Forest Wilderness. No operator shall construct roads across National Forest Wilderness unless authorized in writing by the Forest Supervisor in accordance with § 252.12.

(d) On all mining claims validly established on lands within the National Wilderness Preservation System, the operator shall take all reasonable measures to remove any structures, equipment and other facilities no longer needed for mining purposes in accordance with the provisions in § 252.10 and restore the surface in accordance with the requirements in § 252.8(g).

(e) The title to timber on patented claims validly established after the land was included within the National Wilderness Preservation System remains in the United States, subject to a right to cut and use timber for mining purposes. So much of the mature timber may be cut and used as is needed in the extraction, removal, and beneficiation of the mineral deposits, if needed timber is not otherwise reasonably available. The cutting shall comply with the requirements for sound principles of forest management as defined by the National Forest rules and regulations and set forth in stipulations to be included in the plan of operations, which as a minimum incorporate the following basic principles of forest management:

(1) Harvesting operations shall be so conducted as to minimize soil movement and damage from water runoff; and

(2) Slash shall be disposed of and other precautions shall be taken to minimize damage from forest insects, disease, and fire.

(f) The Chief, Forest Service, shall allow any activity, including prospecting, for the purpose of gathering information about minerals in National Forest Wilderness except that any such activity for gathering information shall be carried on in a manner compatible with the preservation of the wilderness environment as specified in the plan of operations.

(78 Stat. 890) (16 U.S.C. 1131–1136))

PART 293—WILDERNESS-PRIMITIVE AREAS

3. The regulations of Part 293 were transferred from Part 251 on March 5, 1973 (38 FR 5851). The new Part 293 is further amended by revising §§ 293.13, 293.14 and 293.15. Regulations applicable to activities under the 1872 mining law in National Forest Wilderness now appear in Part 252 rather than Part 293.

Sections 293.13–293.15 are revised to read as follows:

§ 293.13 Access to valid occupancies.

Persons with valid occupancies wholly within National Forest Wilderness shall be permitted access to such surrounded occupancies by means consistent with the preservation of National Forest Wilderness which have been or are being customarily used with respect to other such occupancies surrounded by National Forest Wilderness. The Forest Service will, when appropriate, issue permits which shall prescribe the routes of travel to and from the surrounded occupancies, the mode of travel, and other conditions reasonably necessary to preserve the National Forest Wilderness.

§ 293.14 Mineral leases and mineral permits.

(a) All laws pertaining to mineral leasing shall extend to each National Forest Wilderness for the period specified in the Wilderness Act or subsequent establishing legislation to the same extent they were applicable prior to the date the Wilderness was designated by Congress as a part of the National Wilderness Preservation System. No person shall have any right or interest in or to any mineral deposits which may be discovered through prospecting or other information-gathering activity after the legal date on which the laws pertaining to mineral leasing cease to apply to the specific Wilderness, nor shall any person after such date have any preference in applying for a mineral lease, license, or permit.

(b) Mineral leases, permits, and licenses covering lands within National Forest Wilderness will contain reasonable stipulations for the protection of the wilderness character of the land consistent with the use of the land for purposes for which they are leased, permitted, or licensed. The Chief, Forest Service, shall specify the conditions to be included in such stipulations.

(c) Permits shall not be issued for the removal of mineral materials commonly known as "common varieties" under the Minerals Act of July 31, 1947, as amended and supplemented (30 U.S.C. 601–604).

§ 293.15 Gathering Information about Resources other than Minerals.

(a) The Chief, Forest Service, shall allow any activity, for the purpose of gathering information about resources, other than minerals, in National Forest Wilderness, except that any such activity for gathering information shall be carried on in a manner compatible with the preservation of the wilderness environment. Prospecting for minerals or any activity for the purpose of gathering information about minerals in National Forest Wilderness is subject to the regulations in Part 252 of this title.

(b) No overland motor vehicle or other form of mechanical overland transport may be used in connection with any activity for the purpose of gathering information about resources, other than minerals, except as authorized by the Chief, Forest Service.

(c) Any person desiring to use motorized equipment, to land aircraft, or to make substantial excavations for the purpose of gathering information about resources, other than minerals, shall apply in writing to the Office of the Forest Supervisor or District Ranger having jurisdiction over the land involved. Excavations shall be considered "substantial" which singularly or collectively exceed 200 cubic feet within any area which can be bounded by a rectangle containing 20 surface acres. Such use or excavation may be authorized by a permit issued by the Forest Service. Such permits may provide for the protection of National Forest resources, including wilderness values, protection of the public, and restoration of disturbed areas, including the posting of performance bonds.

(d) Prospecting for water resources and the establishment of new reservoirs, water-conservation works, power projects, transmission lines, and other facilities needed in the public interest and the subsequent maintenance of such facilities, all pursuant to section (4)(d) (4) (1) of the Wilderness Act, will be permitted when and as authorized by the President.

(30 Stat. 35, as amended (16 U.S.C. 551); 78 Stat. 890 (16 U.S.C. 1131-1136).

PAUL A. VANDER MYDE,
Deputy Assistant Secretary for Conservation, Research and Education.

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